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II Nos 1-5

MEMOIRS

OF THE

CALIFORNIA ACADEMY OF SCIENCES.

Vol. II, No. 1.

ON THE ANATOMY OF SUTROA ROSTRATA, A NEW ANNELID OF THE FAMILY LUMBRICULINA.

By GUSTAV EISEN.

SAN FRANCISCO, CAL.,
January, 1888.

MEMOIRS

OF THE

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I. ON THE ANATOMY OF SUTROA ROSTRATA, A NEW ANNELID OF THE FAMILY OF LUMBRICULINA.

By GUSTAV EISEN.

The oligochætous annelid, which is the subject of this monograph, was first found by me some ten years ago in the small body of water known as Mountain Lake, situated close to the Marine Hospital, on the Reservation west of San Francisco, California. During a recent visit to the same locality, in May, 1887, I found the same worm in exactly the same part of the lake, but, as before, in very few specimens. Perceiving the necessity of creating a new genus for this oligochæte, I have done myself the honor to dedicate the same to Mr. Adolph Sutro, whose magnificent public scientific library, marine aquarium and zoölogical station on the Pacific Coast will in the near future become one of the most prominent and valuable institutions of learning in this country.

OLIGOCHÆTA.

Family. Lumbriculidæ.

A. Sub-family TRICHODRILINA Vejd.

No solitary albuminous gland opening on the ventral side of the body.

B. Sub-family LUMBRICULINA Vejd.

A solitary albuminous gland opening on the ventral side of one of the anterior segments. Of this sub-family three genera are now known:

1. Lumbriculus Grube.

Four pairs of seminal receptacles in segments 8, 10, 11 and 12. A solitary albuminous gland in the ninth segment. The free secondary perigastric vessels begin in the thirteenth segment, and are all pulsating. The preseptal secondary vessels not branching, the postseptal one branching. Spines not distinctly forked.* Cephalic lobe not filiform.

---

* Vejdovsky, System, etc., der Oligochæten, Prague, 1884, pag. 52.

2. Rhynchelmis Hoffm.

One pair receptacles in the eighth segment. A solitary albuminous gland in the ninth segment. The postseptal secondary vessels are simple, the preseptal ones are feathered and branched. Spines are entire. Cephalic lobe filiform.*

3. Sutroa n. gen.

Seminal receptacles consist of several pairs of lobes, entire or forked, which all open in the so-called albuminous gland in the eighth segment. A solitary albuminous gland in the eighth segment. Preseptal and interseptal secondary dorsal vessel are branching and feathered. Postseptal vessels are gastric, not feathered nor branching. Spines simple, not forked. Cephalic lobe filiform.

It will thus be seen that *Sutroa* is nearly allied to the two other genera of the sub-family, the most prominent characteristic being the concentration of the receptacles and their opening into the albuminous gland. But the vascular system also shows some great peculiarities, which will soon be fully described.

As only one species is known of the genus *Sutroa*, the generic and specific characteristics will here necessarily be considered together.

Sutroa rostrata n. gen. et sp

Habitat.—I have found this species only in Mountain Lake, near the Marine Hospital, west of San Francisco, California. It occurs here only on the north shore, just at the mouth of a small spring, which empties into the lake. It lives in the richest mud, between the roots of aquatic plants, probably with the tail vibrating in the water. When captured and set free in the water, the worms swim rapidly through a peculiar wavy motion of the body, showing to advantage its really magnificent iridescent colors, found to the same degree in no other fresh water annelide. The color of the body is very similar to that of *Rhynchelmis limosella*, a lively fleshy red.

The worm appears to be quite rare, as I did not succeed in getting over a dozen worms during each excursion. It also seems quite restricted to a certain part of the lake, where it lives in the rich mud at the margin of the bank. On the south, east or west ends of the lake I have looked for it in vain.

The egg capsule or cocoons of *Sutroa* are in size nearly similar to those of *Rhynchelmis*, but in shape different. They can nearest be compared to the hanging nests of some birds—small, bag-shaped bodies, with a flat, somewhat concave top—suspended by a long semicircular membrane. Figure 15 gives an enlarged representation of the same. I generally found three eggs or young worms in the capsule.

---

* Vejdovsky, l. c., pag. 52.

The worms appear fully developed in July and August, at which time I found mature specimens. In May only immature ones were found, but as some of those were quite small it is likely that the worms remain mature for a long period, and that perhaps the proper breeding season is during the winter months.

In *size* and *form Sutroa rostrata* much resembles *Rhynchelmis limosella*, Hoffm. Mature specimen reach a length of three inches and a width of one-eighth of an inch, but generally are considerably smaller. The *form* is also similar to that of the above worm. The body is round or quadilateral; in many specimens the sides are even concave (Fig. 3). The posterior part of the body is again very much flattened out, quite transparent, and so brittle that care is necessary to get any entire specimen.

The anterior part of the worm, or the cephalic lobe proper, is elongated and filiform, its length exceeding the width of the body. This characteristic is also found in *Rhynchelmis limosella*, and indeed so similar are the two worms exteriorly that one may easily be mistaken for the other. Fig. 1 represents a *Sutroa*, nat. size; Fig. 2, the anterior portion of the body; and Fig. 3, a transverse section of a quadilateral specimen.

Vascular System.—The dorsal vessel (Figs. 4 and 5, v. d.) is pulsating. The ventral vessel (Fig. 4, v. v.) is not pulsating. In the figures the pulsating vessel is represented red, the non-pulsating one as blue. The ventral and dorsal primary vessels are connected in the cephalic lobe, where at the apex one vessel connects directly with the other (Fig. 4, I). Between this cephalic plexus and segment XIII no direct connection exists between the two primary vessels. But from segment XIII toward the posterior end of the body, we find in every one a secondary gastric vessel which undoubtedly connects the dorsal and ventral primary trunks.

The *dorsal* primary vessel (Figs. 4 and 5, d. v.) is entire, not forked, as is the case in the other genera of *Lumbriculina*. In every segment it emits secondary vessels, which are of two kinds, *gastric* and *perigastric*. The perigastric vessels occur in all the segments of the body; the gastric vessels only in the posterior, beginning with segment VIII.

In each of the six anterior segments we find only one pair of perigastric vessels, but each vessel shows a distinct forking, less so in segment I, but more distinct in the others. In segment VI the forking is so deep that it nearly divides the vessel in two (Fig. 4, I to VI). In segment VII the forking is perfect, and from that toward the end of the body we find in every segment two distinct pairs of perigastric vessels. Each of these vessels again are forked at the apex, and feathered—that is, besides the forking at the apex, it emits two pairs of side branches. All these secondary perigastric vessels end blindly in the perigastric cavity and do not connect directly with the ventral vessel (Fig. 5).

The *ventral vessel* is not pulsating. It is forked in segment VIII, the forks again uniting with the *dorsal vessel* in the *cephalic lobe* (Fig. 4). A similar forking of the ventral vessel is known in the other genera of *Lumbriculidæ*. The two forks of the dorsal vessel are again connected by secondary perigastric vessels (Fig. 4, v. pr. v.), which, however, in no way connect with the dorsal vessel or its secondary perigastric vessels. In *Rhynchelmis limosella* * as well as in *Phreatothrix* † the contrary takes place. Here the secondary ventral vessels connect the ventral forks with the dorsal pulsating vessel. My observations on the transparent *Sutroa* satisfy me positively that my above description is correct, and that the dorsal and ventral vessels are not united in those segments. The blood in all the vessels is lively yellowish-red.

The *alimentary canal* is extremely simple, consisting of a simple duct. In the twelve anterior segments this duct is narrow and quite pellucid, but in the thirteenth segment it is considerably enlarged and continues so toward the posterior part of the body. In the same segment we first meet with gastric vessels.

The *nervous system* resembles that of *Rhynchelmis*. The two ventral nerve cords are, as in *Eclipidrilus*, connected by numerous anastomosing commissures. The *cephalic ganglion* is rather long and narrow. No lateral nerves project from the ventral nerve cord.

Generative System.—The sexual organs are of two kinds—*generative* and *receptive*. The generative include:

Testes, *ovaries* and *albuminiferous gland.*

The receptive are: *Efferent ducts*, with *atrium* and *seminal vesicle; oviducts* and *receptacles.*

---

* Vejdovsky: Anatomische studien. *Rhynchelmis*, Zeitsch, f. w. Zoöl. Bd. XXVII, Taf. XXI, Fig. 1.

† The same. Ueber *Phreatothrix*. Same, Bd. XXVII, Taf. XXXIX, Fig. 2.

The *testes* consist of one pair, situated in segment IX, and attached to the dissepiment between segments VIII and IX. They present small bodies of rather irregular shape (Fig. 14, test.).

The *ovaries* also consist of one pair, situated in segment X, and attached to the dissepiment between segments IX and X. They are somewhat smaller than the testes, and of a more regular form (Fig. 14, ov.).

The *oviducts* consist of one pair of small cup or funnel-shaped organs (Fig. 14, ovd., and Fig. 11). The exterior porus is on the ventral side of the body between segments XI and XII. The interior funnel-shaped part is extremely delicate and translucent. I found the eggs quite frequently in the act of passing out. The oviduct of *Sutroa* differs from that of *Rhynchelmis*, in being somewhat more elongated, with a longer and narrower neck.

The *efferent ducts* are four, and their funnel-shaped interior openings are all found in segment XI, freely projecting from the dissepiment between segments X and XI (Fig. 17). These *efferent ducts* are extremely long, extending through some twenty segments, or from XI to XXX or XXXI. They here enter the atrium, which is similarly elongated, extending from segment X to XXXI. The exterior porus of the atrium is situated very near the center of the ventral side of the line between segments X and XI. This enormous development of the efferent ducts and atrium was previously only found in *Ocnerodrilus*.*

The efferent funnels are comparatively small (Figs. 6, 7 and 14).

---

*I will here take occasion to correct an error in my former description of this latter genus, for which see "*On the Anatomy of Ocnerodrilus*. Upsala 1878." The organs which I have there described as *seminal receptacles* are undoubtedly nothing but the *atrium*. During a visit to Central America, I found four new species of *Ocnerodrilus*, and a cursory microscopic investigation showed me immediately that seminal receptacles existed in several pairs in some of the anterior segments, which makes it evident that the large bodies which open in the same porus as the efferent ducts must be considered as atrium. In the Californian species which I described as *Ocnerodrilus occidentalis*, these small seminal receptacles were evidently overlooked. Professor Fr. Vejdovsky, in his admirable work, "System der Oligochæten," page 144, takes the same view of these organs, and refers to them correctly as the atrium. I now beg to append a correct diagnosis of the genus *Ocnerodrilus*: *Dorsal vessel weakly pulsating*, in segments IX and X; *furnished with two pairs of strongly pulsating hearts*. In the eighth segment it emits two side *branches which continue toward the cephalic lobe*. VENTRAL VESSEL *is not forked, but continues undivided to the buccalic segment. The secondary vessels are of two kinds*, GASTRIC *and* PERIGASTRIC. *The perigastric ones only connect with the ventral vessel. The efferent ducts are not united with the atrium, but both open in the same porus.* SEMINAL RECEPTACLES *occur in pairs in several of the anterior segments.* TESTES—*Two pairs in ninth and tenth segments. Two* OVIDUCTS *in fourteenth segment.* OVARIES—*One pair in twelfth segment*. The genus *Ocnerodrilus* constitutes undoubtedly a distinct family.

oped. In the albuminous gland, however, I have searched in vain for any, though I must confess the number of specimens at my disposal has been very small.

The *segmental organs* are found in all the segments posterior to XII. They consist of long slender organs, the body of which is destitute of any glandular appendices or cells similar to those found in *Rhynchelmis*. The interior opening of the organ is surrounded by brown glands, behind which there is a larger head-like enlargement of similar structure to the duct proper (Fig. 12).

The *spines* are eight in every segment and occur in four pairs. They are slightly S-shaped, entire, not forked (Fig. 13).

EXPLANATION OF THE FIGURES.

PLATE I.

Fig. 1. *Sutroa rostrata*, natural size.

Fig. 2. Front part of the worm, with the cephalic lobe, showing its filiform elongation.

Fig. 3. Transverse section of the body of a quadrilateral specimen.

Fig. 4. The front part of the worm, showing the vascular or circulatory system. The dorsal vessel is represented red; the ventral vessel, blue.
d. pr. v.: dorsal perigastric vessel.
v. pr. v.: ventral perigastric vessel.

Fig. 5. The twelfth to fourteenth segments, showing the vascular system in those segments.
ac.: alimentary canal.
dv.: dorsal vessel.
d. pr. v.: dorsal perigastric vessel.
d. gr. v.: dorsal gastric vessel.

Fig. 6. The efferent ducts and atrium.
ps.: penis.
eff. d.: efferent ducts.
atr.: atrium.

Fig. 7. Efferent funnel more magnified and seen in different aspect.

PLATE II.

Fig. 8. Ventral nerve trunk and cephalic ganglion.

Fig. 9. Seminal receptacles and albuminous gland.
re. sem.: seminal receptacles.
gl. alb.: albuminous gland.

Fig. 10. Interior extremity of one of the receptacles, showing the spermatozoa accumulated in the same.

Fig. 11. One of the oviducts, with eggs in the act of descending.

Fig. 12. The interior extremity of one of the segmental organs.

Fig. 13. One pair of spines.

Fig. 14. Interior view of the ventral part of the worm.
gl. alb.: albuminous gland.
re. sem.: seminal receptacles.
test.: testes.
ov.: ovaries.
ovd.: oviducts.
atr.: atrium.
eff. d.: efferent ducts.

Fig. 15. One of the egg capsules or cocoons. In the interior are seen three young worms, magnified about five times.

The Roman numerals everywhere indicate the segments. In numbering the same I have everywhere in this paper referred to the first segment as segment I, thus following Vejdovsky and others. In former papers I have always referred to the first setigerous segment as segment 1, and believe yet this way to be the least confusing. But as uniformity in numerating the segments is highly desirable, and as every investigator seems to have his pet way, leading to endless misunderstanding, I shall for the future accept the system used in this paper, hoping all other investigators will do the same.

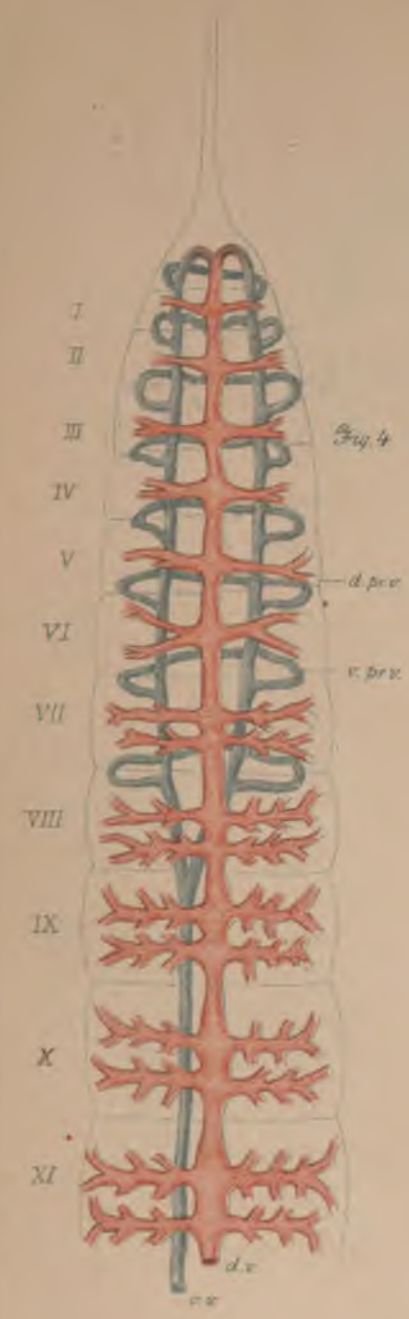


Fig. 4

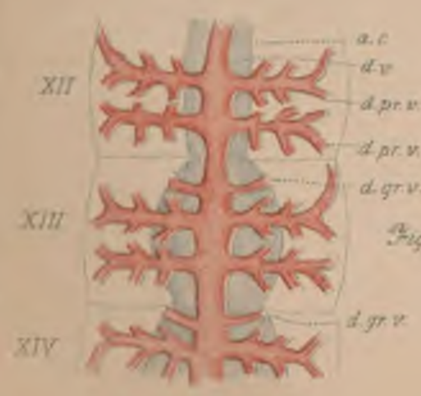
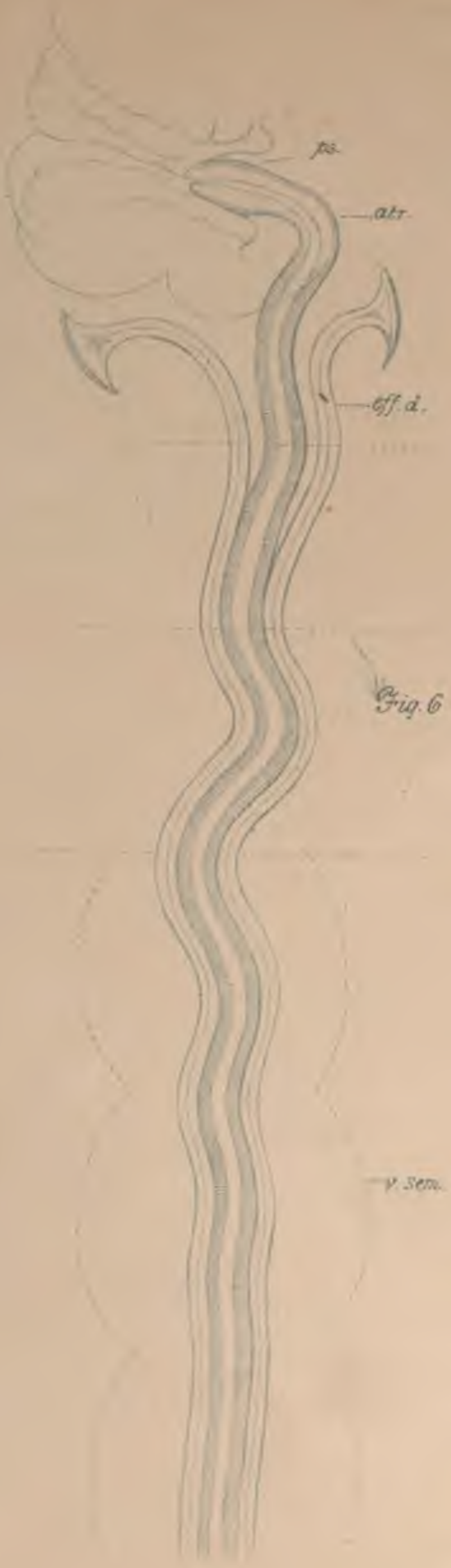


Fig. 5



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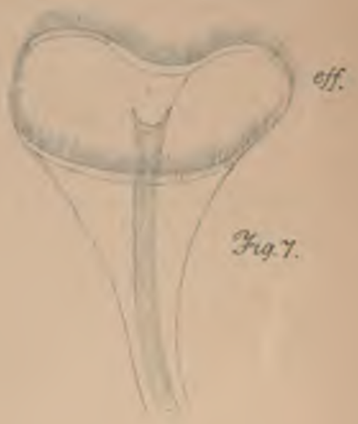

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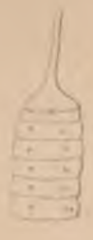
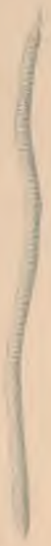


Fig 2

Fig 3



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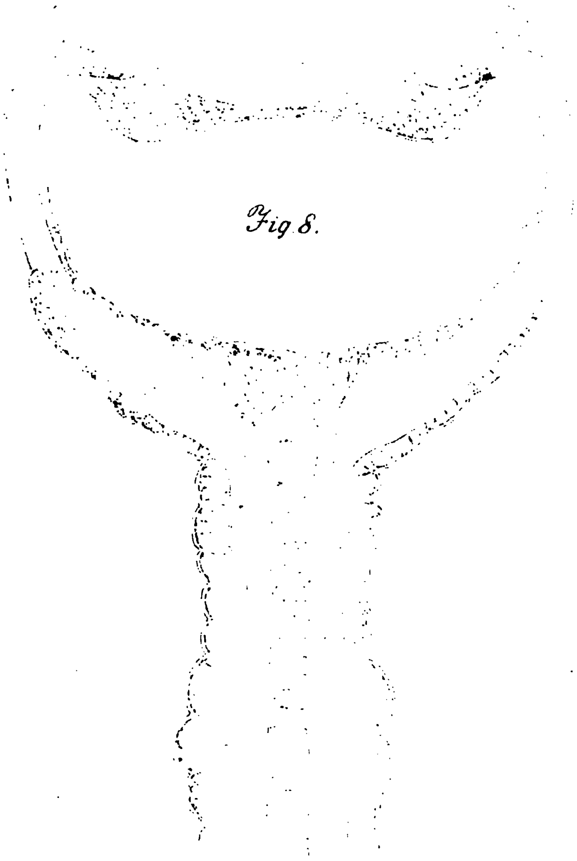

Fig. 8.

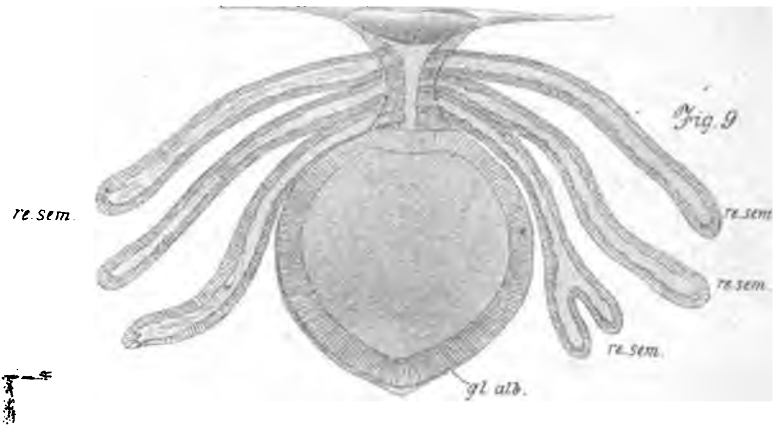

Fig. 9

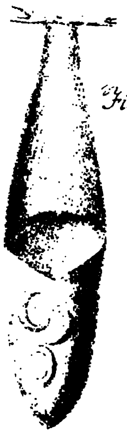

Fig. 15

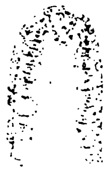

Fig. 10

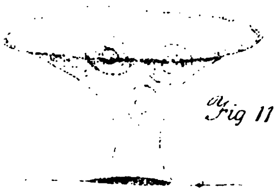

Fig. 11

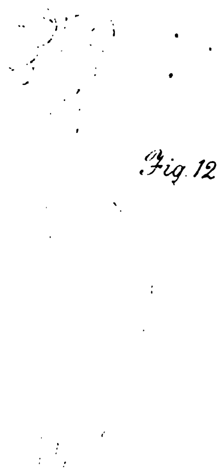

Fig. 12

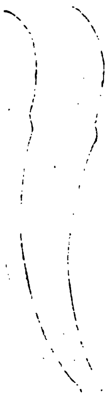

Fig. 13.

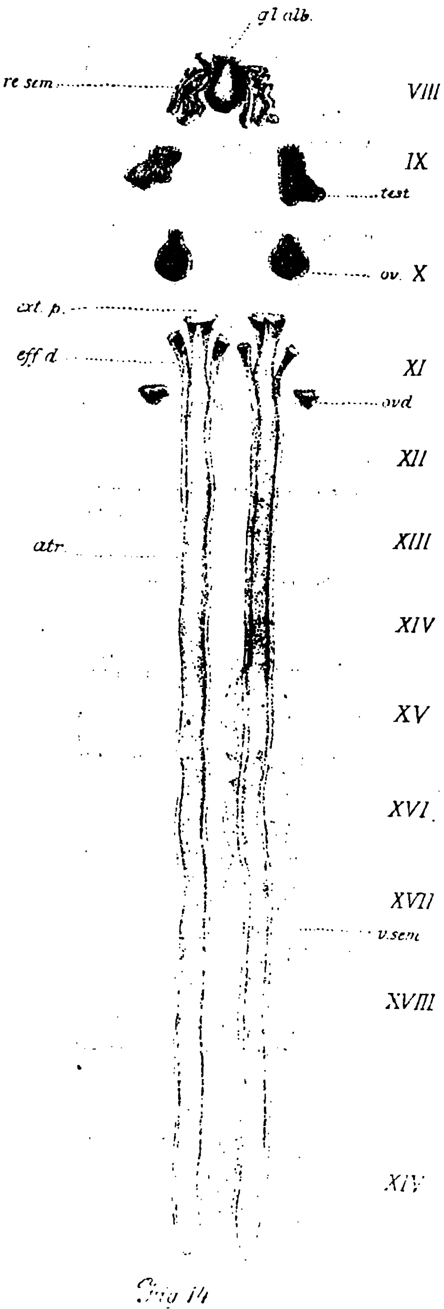

Fig. 14

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ON SOME ANCIENT SCULPTURES FROM THE PACIFIC SLOPE OF GUATEMALA.

BY GUSTAV EISEN.

SAN FRANCISCO, CAL.,
JULY, 1888.

ON SOME ANCIENT SCULPTURES FROM THE PACIFIC SLOPE OF GUATEMALA.

BY GUSTAV EISEN.

During my visit to Guatemala, Honduras and Salvador, in 1882, I made the archæological remains of the Mayas and the Aztecs in those countries my particular study. These researches were embodied in a paper presented to the Smithsonian Institute in 1883. This paper treated principally of the ruins of Copán and Quirigua, in Honduras and Guatemala. Through an unfortunate mishap a portion of this paper was lost in transferring from the Smithsonian Institute to the Bureau of Ethnology in Washington, D. C. This delayed the printing of the same four years. In the meantime Mr. Alfred Maudslay, of London, carried on extensive excavations in both the above places. His researches being so much more extensive than my own, and now soon to be published, will in a measure supersede them, and make their publication less desirable or entirely superfluous.

The following paper contains only those portions of my former researches which refer to parts not visited by Mr. Maudslay. The historical traditions of these localities are entirely lost, and instead of indulging in vague and at present highly unsatisfactory speculations about possible relations, life, characteristics, etc., of the people who produced the sculptures found there, I shall mainly confine myself to describing what I have seen, leaving future explorers, with more material, to generalize and speculate upon the, of late, rather fashionable myths of Tlalocs, Quetzalcoatle, Toltecs, etc.; but this much I will say in regard to the people who originated these sculptures—that they were, undoubtedly, of Aztec origin; the worn gylphs yet to be distinguished show similarity to Aztec and not to Maya writings.

EL PORTÁL, PANTALEÓN, LOS TARROS, SANTA RITA, SANTA LUCIA COTZUMALGUAPA AND AGUNÁ.

In the above named places as well as in many others along the Pacific Coast of Guatemala, from the very slope of the volcanoes to the shores of the Pacific Ocean, are found numerous traces of ancient civilization. So numerous seems the population of the country to have once been that there is now scarcely a single farm upon which is not found ruins or relics of some kind. But the monuments on this coast are of an entirely different type from those of Guirigua and Copán, and it is perfectly evident that they were constructed by entirely different people, who resembled each other, neither in regard to physiognomy, dress or ornaments, nor in regard to the glyphs used for expressing their ideas, etc. The monuments of the Pacific Coast are of several kinds, viz.:

1. Larger or smaller hills or mounds made of soil, or soil and rough or rounded stones. Generally three or four of these mounds are grouped together forming between them a kind of inclosed courtyard. Some hills are several thousand feet in length and some twenty feet high; others only fifty to sixty feet long, the height being the same as the former.

2. Smaller mounds, in which are seen a low foundation of rough stone, not fixed with mortar.

3. Bridges and aqueducts made of cut stones, beautifully laid without mortar, and wonderfully withstanding the destruction of time. Such are found around Santa Lucia and Los Tarros.

4. Sculptured stones, representing heads of men or animals, in all grades of skillful manufacture, some most beautifully made and designed, such as the large head from Los Tarros; others again very primitive, like those of Aguná.

5. Hollow stones or fonts, richly ornamented, used either for baptism or for sacrifices.

6. Sculptures in low relief, representing mythological or historical events, or records of some kind.

7. Pottery of different kinds, such as dishes, vases, and musical instruments with heads of beasts and man; also smaller idols of burnt clay. This pottery is evidently from different epochs. The finest made wares are found near or on the surface, while the poorest kinds are found deeper in the ground, as far down as nine feet. I have this assertion from several gentlemen owning farms on the coast, especially from Don Joaquin Durand, who has repeatedly found ancient pottery at different depths on his farm — "Sapote," at the base of Volcan de Fuego. In our present time no such wares are worked by the Indians anywhere on this coast, nor can the present crockery of the Guatemala Indians, in skillful workmanship or even in the fineness of the clay used, compare with the ancient pottery found in the ground. Only in the wild and entirely unconquered country of the Lacandres, between Guatemala and Yucatan, have the natives to this day preserved the art of finer pottery making. Edward Rockstroh, who made an expedition to this country

a few years ago, and who succeeded in penetrating far enough in the same to visit several hamlets or ranchos, brought from there several idols well made. The general form was a small dish, furnished at one side with a large head. These objects were both idols and sacrificiary places. In the hollow of the pots was placed incense or libation, and the god for which it was destined, was represented by the head attached to the dish. These heads, or faces, were in many regards exactly similar to those found on the Pacific Coast, and bore also a remarkable resemblance to the faces and heads of the Peruvian pottery. The ground color of the pots was also a dark grayish-black, while the pottery from the Pacific Coast, as well as that from Copán and other places of Maya origin, is yellowish-red, and sometimes ornamented with painted glyphs.

In the "Instituto Nacional" of Guatemala, is a fine and interesting collection of pottery from different places of that Republic; but like everything else in that country, it is in a deplorable state, the catalogue being missing, so that the numerals on the different objects cannot be referred to. Nobody has charge of the "museum," or takes any interest in the same. Mixed with the ancient Indian pottery are some Egyptian idols, as well as pieces of unburnt European pottery, most likely believed by the "authorities," to be of the same origin, and having as much or as little interest.

The sculptured stone heads found all over the coast are all furnished with a large conical projection, as can be seen by referring to the different figures appended. This projection was evidently formed for insertion into the adobe or stone walls of the respective temples, and served to keep the objects in position. They have no connection with phallic symbols or worship. Most likely, when the sculptures were in their original places, these projections were not seen, but were entirely hidden in the walls.

In producing drawings of different sculptnres, my intention was not, neither did my time permit me, to again draw stones which had once been drawn and photographed by former explorers. My intention was only to bring to notice what was not previously known, and thus, as much as I could, complete the work so ably begun by others. This especially refers to the sculptures of Santa Lucia, where Dr. Habel and Prof. Bastian have already done considerable work. In regard to the sculptures of the other places here referred to, I believe so far no accounts of the same have been published, and I drew there as many as I could find, within the limited time at my disposal.

EL PORTÁL.

The above is the name of a coffee plantation and farm, owned by Don Manuel Herrera, at the time of my visit Minister of Agriculture in the Government of Guatemala. The plantation is situated only a few minutes' walk from "Antigua," the old capital of Guatemala. The monuments of this place comprise a large *natural* hill or mound several hundred feet high, and perhaps five hundred feet in diameter. The top is covered by three smaller mounds, artificially made. From the top of one of these smaller mounds, and down the steep south side of the larger one, is seen the very much ruined remains of a roughly made stairway, the stones once composing its steps having neither been cut nor well fitted. Along the lower part of this stairway, and also between the three small mounds at its top, were found all the sculptures known from this place. At the base of the stairway is yet seen a large basalt block, in which can barely be made out the figure in low relief of a large tiger of natural size. A little higher up are seen several very rough heads of animals, as well as a deer head, but they can hardly be called sculptures, the original stones having somewhat resembled heads, and only been helped by the artist by the addition of a line for the mouth or a hollow for the eye. All the better sculptures were some time since removed to the near dwelling-house and here sheltered from rain and destruction; Señor Herrera being one of the few native gentleman in Guatemala who takes interest in the ancient relics of the country. The following sculptures are all which are at present known from this place. The numerals refer to the figures appended only where "Fig." is put in front of them.

FIGURE 1. Large block of basalt with the upper surface covered with a tiger in bas-relief. The tongue is stretched out, and on the same is seen perched a bird with long bill, very similar to an *Alcedo*. Size 5½ by 3½ feet.

FIGS. 2 and 3. Head of a male personage—Fig. 2 representing the same seen from the side, and Fig. 3 from the front. The face is serene and well made, furnished with a beard. On the head is seen a kind of helmet, the original of which was perhaps made of wood. In this helmet is seen a smaller face, and on the side of it the two arms bent upward. The back is furnished with a projection. Size of Fig. 2, 19 inches long by 14½ inches high. Size of Fig. 3, 14½ inches high by 8½ wide.

FIG. 4. Head of some animal, perhaps a snake, seen from the front. Rectangular posterior projection. Size, 11½ inches high by 13 inches wide. Roughly made sculpture.

FIG. 5. Head of another similar animal, but seen from the side. The upper surface of the skull has inscribed upon it two C's, a similar ornament often being found in snakes. Size, 19 inches long by 11½ inches high.

FIGS. 6 and 7. Head of some fictitious animal, perhaps modeled after a tiger. Fig. 6 represents it seen from the front. Size, 13¾ inches broad by 19 inches high. Fig. 7 is the same seen from the side. Size, 25½ inches long by 19 inches high.

FIG. 8. Head of a fictitious animal. Behind is seen the remains of a hollow, perhaps a font. Front view. Size, 13 inches broad by 8½ inches high.

SANTA RITA OR CARMEN.

This place is situated between Santa Lucia Cotzamalguapa and Pantaleón. So far only one sculpture is found in this place, represented in Figs. 9 and 10. The lower part of the skull is wanting. Fig. 9 represents it seen from the front and Fig. 10 from the side. This skull, as well as the heads from Pantaleón, have the angle of the face very large. The sculpture is at present at Pantaleón.

PANTALEÓN.

This place is situated one league southeast of San Lucia, and belongs at present to Don Manuel Herrera. The sculptures found on this place are removed from their original site, and now to be seen in a yard behind the main dwelling-house. Originally, however, they were found on the ground between four small mounds, enclosing between them a kind of courtyard, having the entrance on the south side. The sculptures consist only of heads of male and female personages, originally six in number, but one of them has been taken to Berlin, Germany, by Dr. Bastian. I am, however, not aware of it having been described. The remaining sculptures are all very well made, cut out of a dark basalt from Volcan de Fuego, some thirty miles distant. The rocks, however, were most likely found on the place, as rounded stones of similar nature are in some places abundant on the ground. All the sculptures are furnished with a large posterior projection for insertion in the wall.

Figs. 11 and 12. Head of an old woman, the face with very deep wrinkles all over. Remarkable in all these heads is the head-dress, which is just the opposite of the head-dresses worn by the idols of Quirigua and Copán. Instead of being enormously large, it is extremely small, and evidently used more as an ornament than as a protection. In this head it consists of a small central bow, from the sides of which extend two wings of feathers. The whole seems attached to some kind of frame, on each side of which hangs down two smaller ribbons and one larger one. Fig. 12 shows this head-dress as seen from above.

FIG. 13. A head of a young woman, of handsome features. The hair is abundant and seems to hang below the ears. These, as in all the rest of the sculptures, are unnaturally large, most likely enlarged by some process. The head-dress is in the form of a crown, or at least ornamented as such. The figure shows the head from the front.

FIGS. 14, 15 and 16. Head of a very old woman, seen respectively from the side, front and from above. The hair is laid in thick tresses and covered by an exceedingly small hat. The ears are enormously large, their lower lobes extending and projecting forward. The most remarkable things to be seen in this face are the eyeballs, which are hanging down outside on the cheeks. The upper lip is small, while the lower one is very large and projecting. The nose is broken, but enough is left to show its original large size.

FIGS. 17, 18 and 19. Head of an old woman, seen respectively from the side, front and from above. The hair is ornamentally laid and covered by a very small hat; by the same is seen a bow. The right eyeball is hanging on the cheek. The nose is large and aquiline, not broken. Below the face is seen a kind of collar extending from ear to ear.

FIGS. 20 and 21. Head of an old man, seen from the side and from above. The nose is partially broken. Forehead and face deeply wrinkled. Head covered by a cloth and a very small hat. The ears have large ornaments.

The size of these five sculptures is nearly the same. Length, 32 inches, hight 24, and width 16 inches.

What these heads represent will at present remain only a conjecture. In Yucatan criminals were punished by the extraction of their eyes, but I am doubtful about these heads representing criminals, as they then would most likely not have been ornamented, as it seems, in so very fashionable a way. Besides, the expressions of their faces are always noble and serene, which would not have been the case if a criminal had been represented. Even those having their eyes extracted show no signs of pain whatever. The faces represent evidently very old people, at least judging by the very deep wrinkles which cover their foreheads and cheeks. May not these heads represent saints, some of whom had martyred themselves and whose images had since been set up for adoration?

I was informed that similar sculptures are not uncommon in the neighborhood, but the above ones are said to be much superior in execution. The following localities are said to contain similar sculptures: Santa Ana or Mistan, about nine leagues south of Pantaleón; Gomera, about ten leagues south of Pantaleón. Also in the vicinity of Santa Lucia six heads were to be seen, which were said to exhibit the peculiarity of having animals and bars projecting from the mouths. Even in a place north of Pantaleón is said to be a large head more than six feet high, in similar style with those removed to the house and described above.

LOS TARROS.

This place is situated northwest of Pantaleón a few leagues distant. I did not visit the place, the time and weather not permitting it. One of the two sculptures found on this place is removed to Pantaleón, and arrangements have already been made to remove the other. Both sculptures are said to be nearly exactly alike, the one remaining in its place only being a little larger. Originally both sculptures stood on a plain facing each other, and 20 to 30 yards apart. Fig. 22 represents the smaller of the sculptures, seen from the front, and Fig. 23 the same seen from the side. The size is: hight, 68 inches; width, 44 inches; thickness, 24 inches. The sculpture represents the bust of some prominent male personage, standing out in bold relief from a stone slab, slightly ornamented. Above the slab is seen the head of a large fictitious animal, with a large hole perforating the base of the same. The face of the personage is most serene and noble, and expresses great kindness. The head-dress is very large, a kind of turban, very much inflated, in front furnished with an ornamental projection, in which is seen a face lying on the side, and in front of this a smaller ornament like a gem. Behind the face are seen three leaves, and behind them, extending towards the margin of the stone slab on each side, a bunch of very long and rather narrow leaves, with a nervation similar to that of *Melastoma*. The ears of the personage are large, furnished with ornaments, in the middle of which is seen a hanging boss. On the breast is an ornament with five small holes in the margin, and a human face in the center. The fantastic head, hanging ominously above the slab, is of a wonderful effect, and the perforation of its side breaks the heaviness of the sculpture. In elegance of design and in workmanship this stone is undoubtedly one of the very finest ever found in Central America; and it is much to be regretted that it is not protected from the injurious influences of the tropical rains and sun. Originally the stone had a large posterior projection, but this was cut off so as to facilitate transportation.

SANTA LUCIA COTZUMALGUAPA.

The sculptures from this place are pretty well known through the works of Dr. Habel* and Dr. Bastian.** Some of the slabs have been removed to Berlin, but the largest part is yet to been seen at the original place, but exposed to rain and other bad treatment. Many of the sculptures are so faint that it is necessary to draw up the lines with chalk before any complete idea can be had of the same.

The sculptures, when originally found, were covered by soil, the same being thrown up into hills or mounds. At present the whole country around is covered with these mounds of smaller and larger size, and as only a few of them have been opened, it is not unlikely that the number of sculptures will be considerably increased when a thorough search has been made. The way the sculptures were, or are, hidden in the ground, is very peculiar. Some of them are lying down flat on or near the top of the mound; others are standing upright, but covered with soil up to their very tops. It is evident that the soil has not accumulated slowly from decayed vegetation, etc., but it seems rather as if the sculptures have once purposely been covered up, to be hidden, perhaps, at the approach of some enemy. At the time of the Spanish conquest the whole of the Pacific Slope was here densely populated, especially around and near Escuintla, from which Santa Lucia is only distant some thirty miles.

Through the kindness of Mr. Edward Rockstroh, I came into posession of some lead pencil and ink drawings of sculptures from Santa Lucia, made by the late Dr. Carl Herman Berendt, and received also permission to publish the same. One of these drawings I had already a copy of, made by myself at Santa Lucia; but as my drawing was wanting in the lower part—this part at my visit being covered with soil—I prefer to give the drawing of Dr. Berendt as being more perfect. As this as well as his other drawings, were not exactly in a state to be lithographed, very often having corrections of minor details on the margins, I recopied them, inserting the corrections, etc. It is to be regretted that no notes as to size accompanied the drawings, and only meager ones as to localities.

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*S. Habel.—The Sculptures of Santa Lucia Cotzumalguapa, etc. Smithsonian Contribution to Knowledge. 269. Apr. 1879.

** The work of Dr. Bastian, in quarto, 3 plates, printed in Berlin? has no title, at least not the copy that I have seen.

Fig. 24. Large stone slab, about nine feet high by six wide. The sculpture represents some religious ceremony. Two men are carrying between each other a standard, and appear to deliver the same to a third person. The standard is ornamented by several appendices, one being especially large and circular, and having in its midst the face of a monkey. In the margin of the stone are seen several round rings with glyphs or signs, but all are so effaced that no correct delineation is possible. This slab is yet standing upright in a mound, and was originally entirely covered with earth, but at present the larger part of the face is uncovered.

Fig. 25. Stone slab found in the grounds of Virgilio Pais, on the plain of Quayabo, near Santa Lucia. Drawing made after a sketch by Dr. C. H. Berendt. The central figure represents a chief richly dressed, with a girdle round the waist, one extremity of the bow ends in a snake-head extending toward the woman standing in front. One of the legs of the chief is ornamented; the other bare. The head-dress, behind which is seen a large bird, perhaps the common black vulture of Central America, is large and ornamented with many feathers. In front of the man stands a woman, evidently emaciated, as her ribs are plainly seen. She appears entirely naked, except a girdle round the loins. Her hair is elegantly dressed and tied with ribbons. Behind her is seen an evil spirit, or other mythical personage, with claws on hands and feet, and a very pronounced male member. The chief has his mouth covered with a bandage.

Fig. 26. Original from the grounds of Virgilio Pais; the drawing after a sketch by Dr. C. H. Berendt. Represents a sepulchral tablet, on which are seen the portraits of perhaps man and wife, their different head-dresses, etc., indicating decidedly their different sexes. From the mouths of the respective portraits extend as usual curved figures with notes or nodes. A similar speech writing is found in all Mexican manuscripts, as can be seen by a reference to Lord Kingsborough's Mexican Antiquities, for instance, Tom. III, p. 26. This writing is entirely unknown in Maya sculptures and manuscripts, but is seen on some sculptures at Chichen, Yucatan.

Fig. 27. From the same locality, and after a sketch by Dr. C. H. Berendt. A stone tablet, most likely, like the former one, a sepulchral tablet, having in its center a forced deadhead, with outstretched tongue. Above the same are seen two crossed bars, perhaps meant to represent two crossed bones.

Figs. 28 and 29. The two sides of a sacrificial font or altar. The front is twenty-four inches high, ornamented with a face like that of a dead man. The ears are enormously large. Above is seen a cavity in the margin, in which perhaps the victims were made to place their heads at decapitation. The hollow posterior cavity of the font, used for the reception of the cut-off head, is twenty-one inches broad by twenty inches deep. Locality: Xata. (After a drawing by Dr. Berendt.)

AGUNÁ.

Situated some twenty miles northwest of Santa Lucia and owned by Dr. Guillermo Rodiguez of Guatemala. The whole place is covered by artificial mounds. About nine miles south of the main dwelling-house are seen, among other hills, three smaller ones made of soil and rough stones. These mounds, perhaps fifteen feet high and forty feet long, are placed so as to form a small courtyard. In this courtyard were found the sculptures here represented, viz.:

Figs. 30 and 31. A stone sculptured as a head, with a posterior projection for insertion in a wall. The sculpture is represented both from the side and from the front.

Figs. 32 and 33. A similar stone, with a forced deadhead in front and several ornaments. In execution these heads do not compare with the sculptures of Pantaleón, being very much inferior, both in design and workmanship. Their size is about four feet long by two high.

EXPLANATION OF THE FIGURES.

FROM EL PORTÁL.

Fig. 1. Sculptured tiger in low relief. The tongue is outstretched and on the same is sitting a bird.
2. Head of male personage, seen from the side.
3. Head of the same, seen from the front.
4. Head of fictitious animal, front view.
5. Head of an animal similar in size and shape to the above, but side view.
6. Head of a fictitious animal, seen from the front.
7. The same, side view.
8. Fictitious animal or deadhead, remains of a font, front view.

FROM SANTA RITA OR CARMEN.

9. Sculptured deadhead of man, seen from the front.
10. The same, side view.

FROM PANTALEÓN.

11. Sculptured head of woman, side view.
12. The former, seen from above, to show the head-dress.
13. Sculptured head of woman, front view.
14. Sculptured head of woman, side view.
15. The same, front view.
16. The same, seen from above, to show the head-dress.
17. Sculptured head of woman, seen from the side.
18. The same, front view.
19. The same, seen from above, to show the head-dress.
20. Sculptured head of woman, seen from the side.
21. The same, seen from above, to show the head-dress.

FROM LOS TARROS.

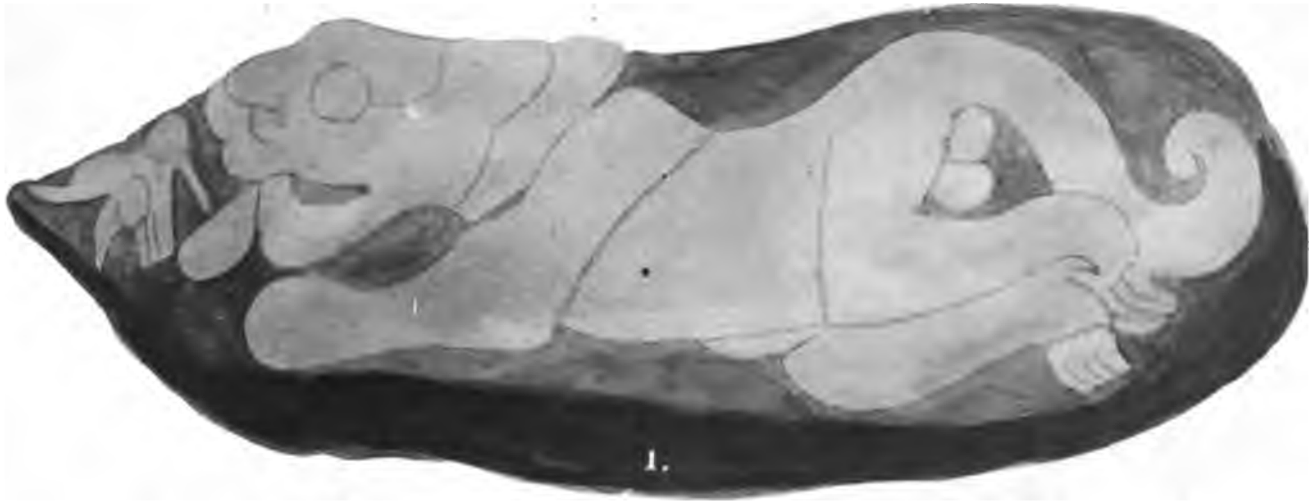
22. Large, sculptured stone slab, in the middle the bust of a male personage; above, a fictitious animal's head.
23. The same, seen from the side.

FROM SANTA LUCIA COTZUMALGUAPA.

24. Large, sculptured stone slab, in very low relief, representing some religious or civil ceremony. Two male personages are seen carrying a standard, and presenting it to a third.
25. A chief or other personage, in rich dress, and head-dress or helmet with plumes. Behind the same is seen a bird; in front, a female figure, and behind her a fictitious personage. The sculpture is in low relief.
26. Smaller sculptured slab, perhaps originally the cover of a tomb or made in memory of the two personages whose portraits are seen on the stone.
27. Sepulchral stone slab; in center the image of a deadhead surrounded by many ornaments.
28. Sacrificial font, seen from the side. The font has a shield with a sculptured face.
29. The same as above, front view. The small cavity in the top was evidently used for holding the victim's neck; the font behind receiving the head when decapitated.

FROM AGUNÁ.

30. Sculptured stone head, with posterior projection; seen from the side.
31. The same; front view.
32. Sculptured stone head—a forced deadhead, with ornaments; front view.
33. The same; side view.

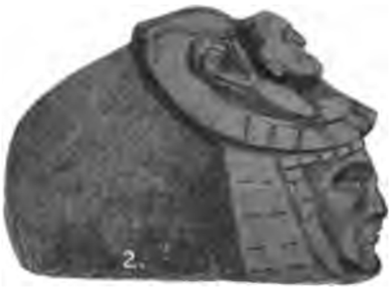


1.

GUSTAV EISEN, del.
9/1882.

Sculptures of El Portál, Guatemala

ARTO, BRITTON & REY, S F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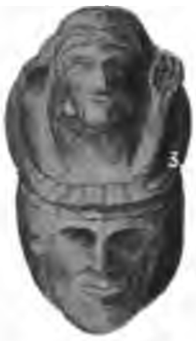
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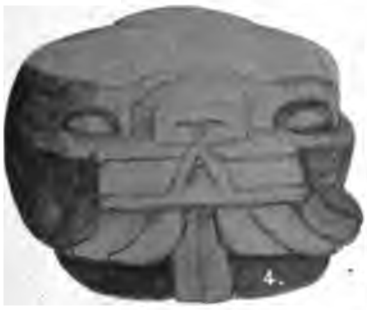
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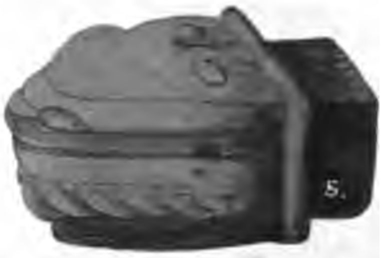
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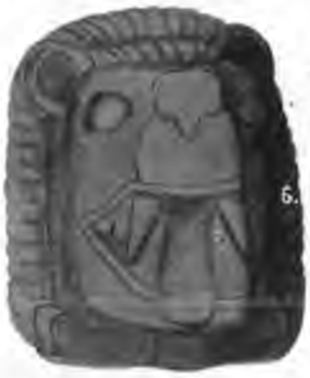
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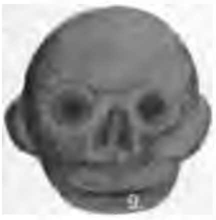
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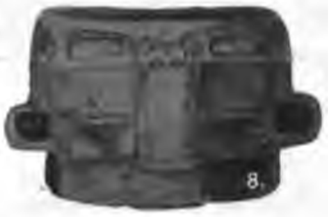
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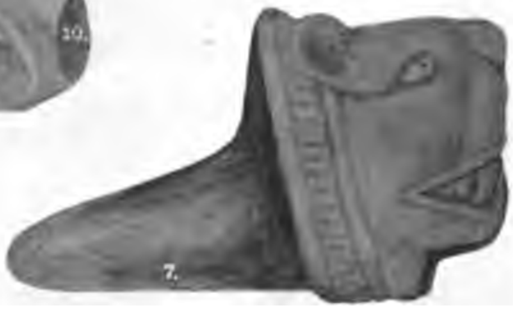
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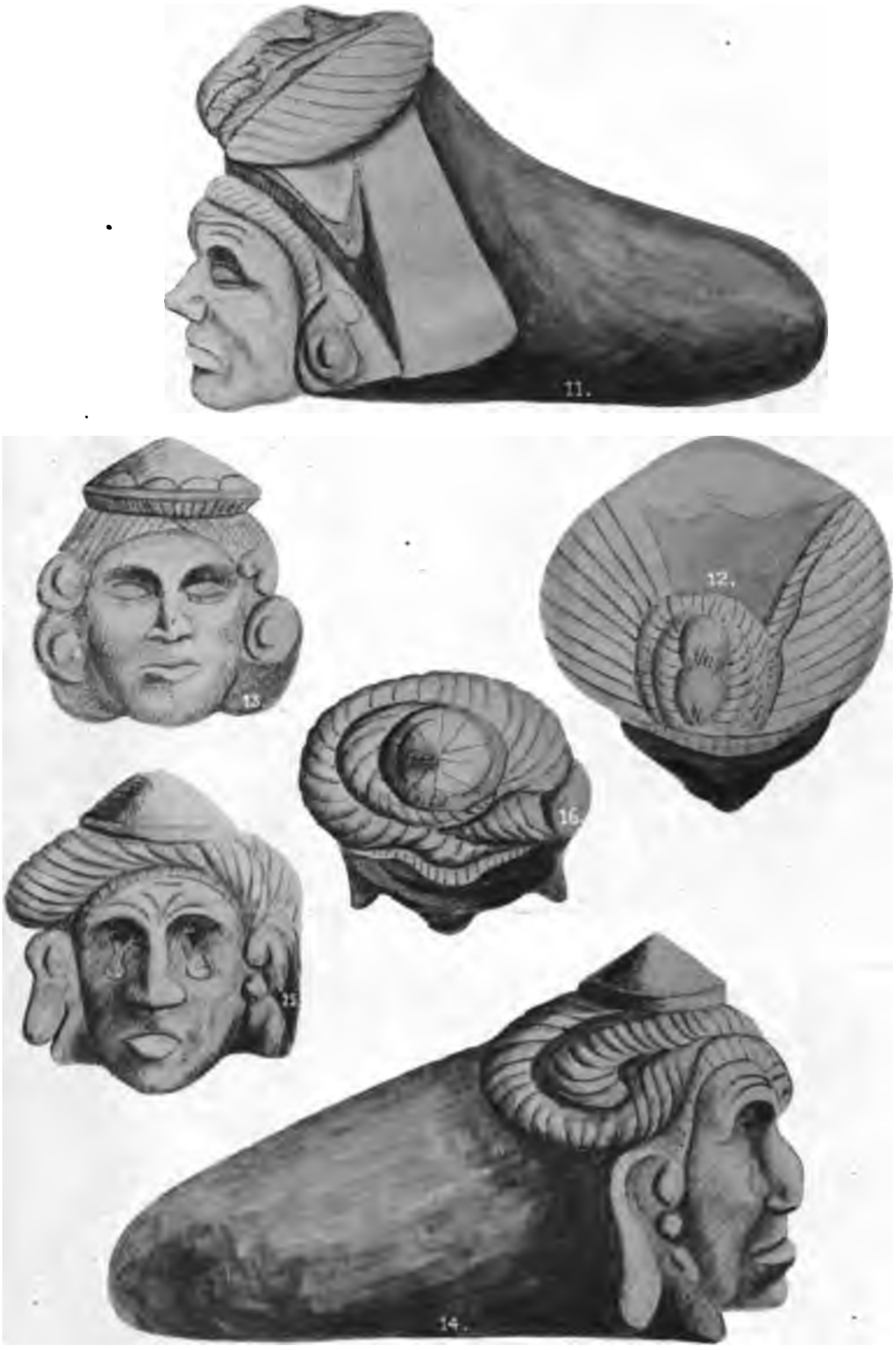
Gustav Eisen, del.
9/1882.

Arto. Britton & Rey S.F.

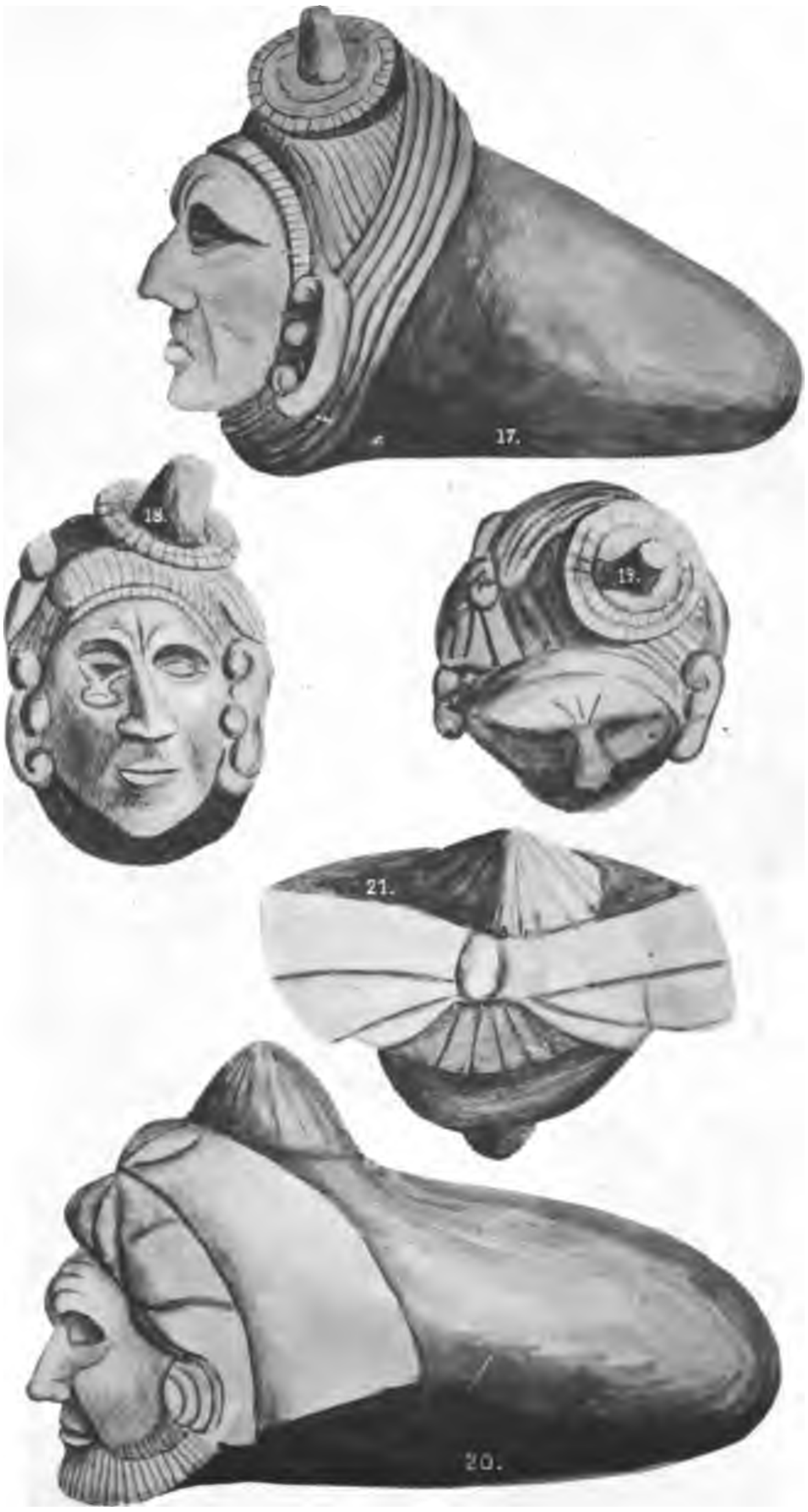
Sculptures of Portál, Antiqua;
and Santa Rita or Carmen, Pantaleón, Guatemala.



Gustav Eisen, del.
9/1882.

Arto Britton & Rey, S F

Sculptures of Pantaleón. Guatemala.



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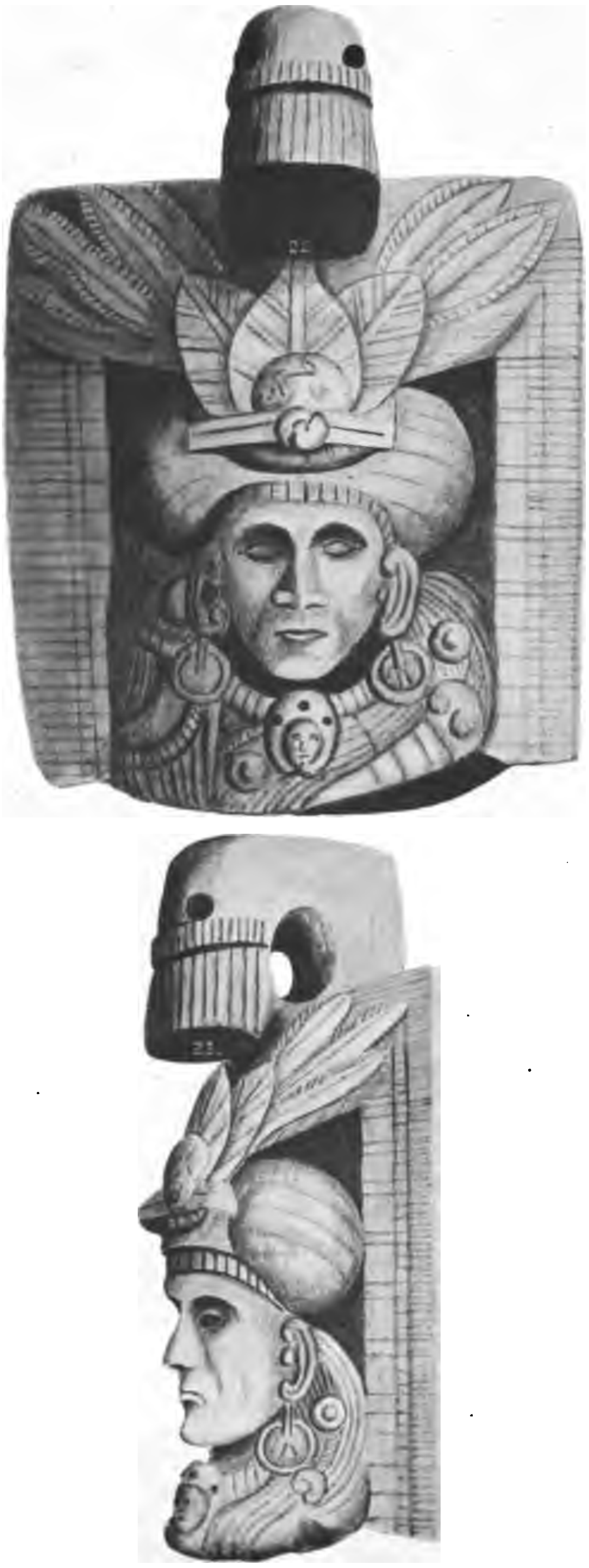
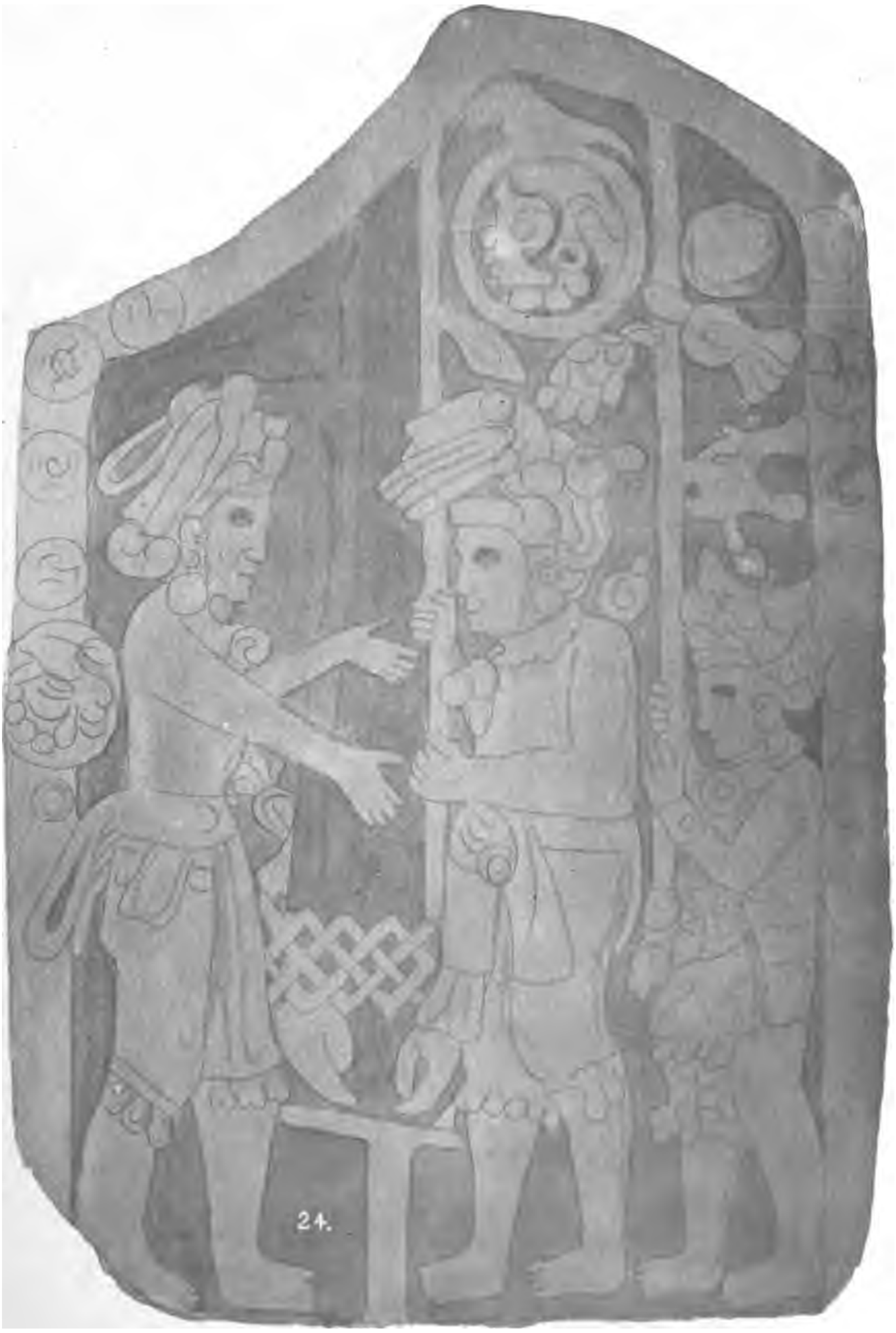
Sculptures of Pantaleón, Guatemala.



Gustav Eisen, del.

Arto. Britton & Rey S.F.

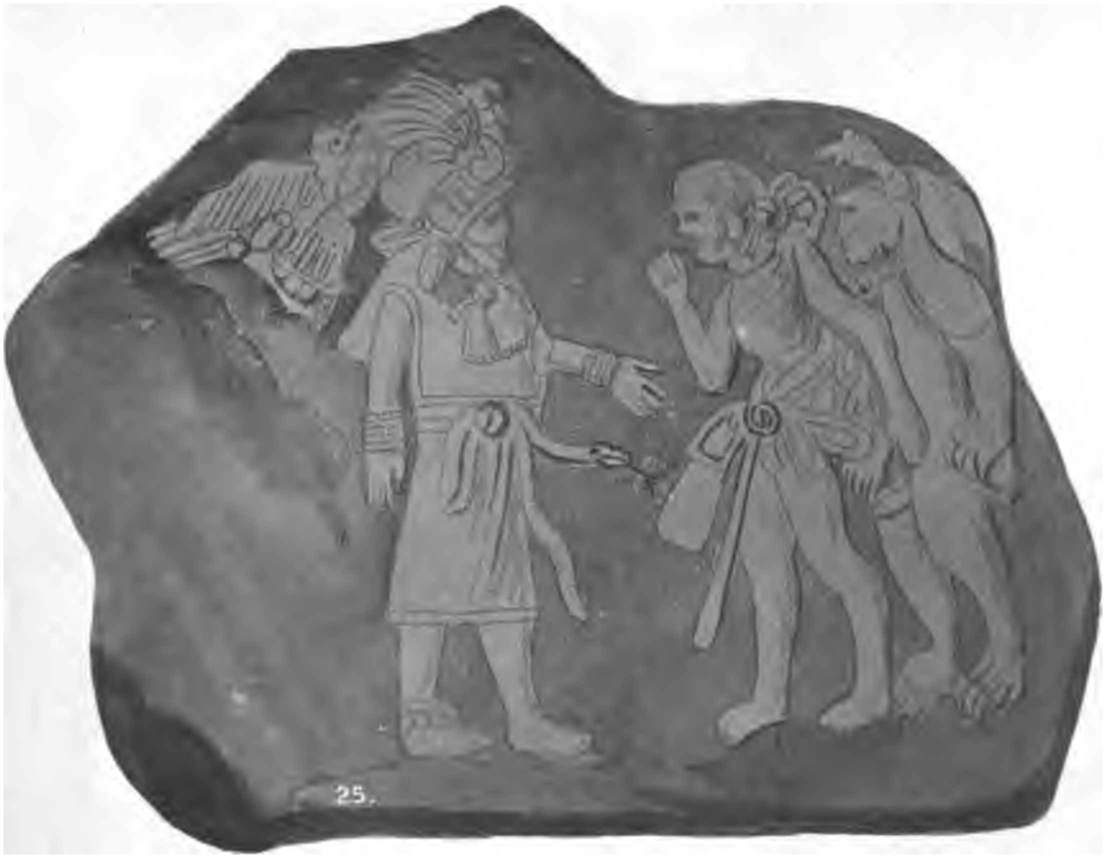
Sculptures of Los Tarros, Pantaleón, Guatemala.



GUSTAV EISEN, in part, after sketch by Dr. Berendt.
4/1882.

ARTO. BRITTON & REY, S F

Sculptures of Santa Lucia Cotzumalguapa, Guatemala.



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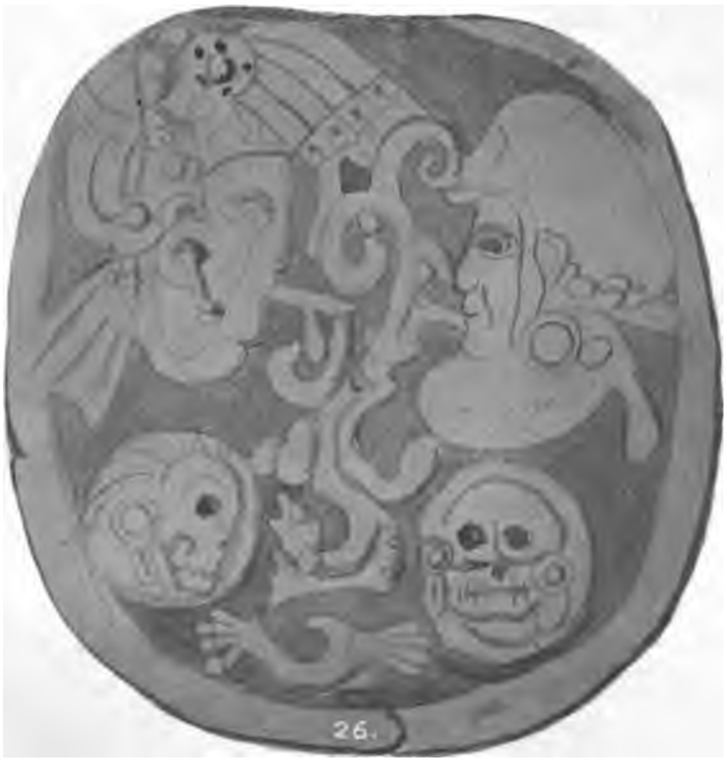

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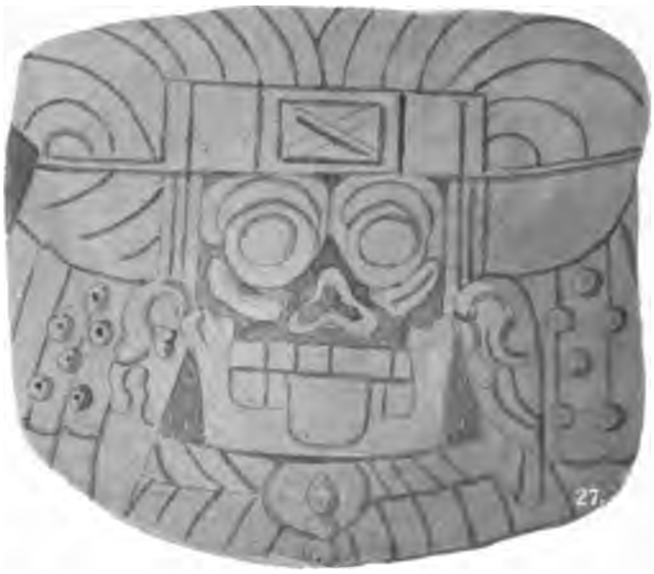
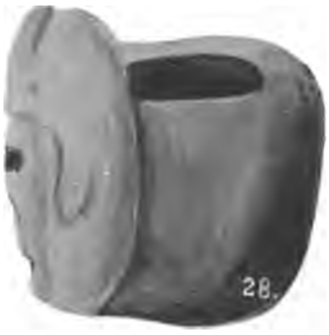
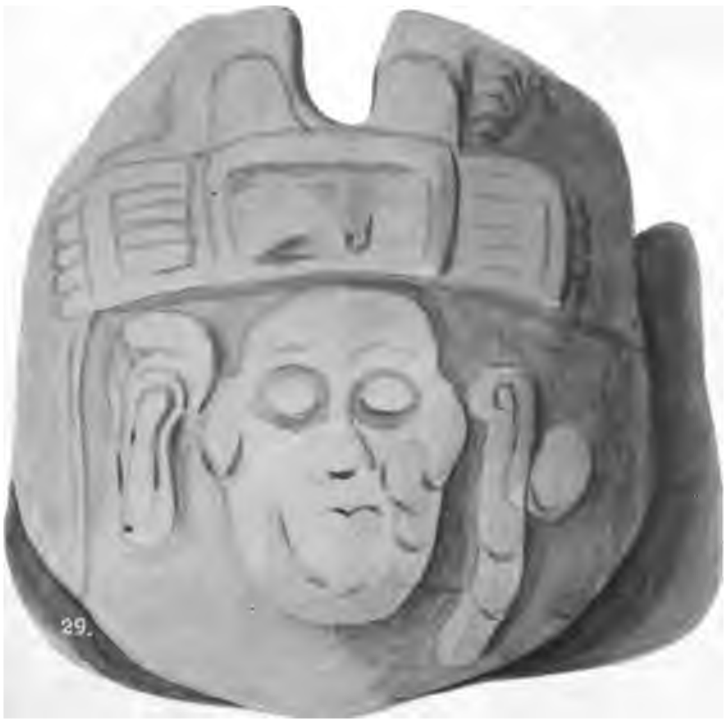
GUSTAV EISEN, after sketch by Dr. Berendt.
8/1882.

ARTO. BRITTON & REY, S F

Sculptures of Santa Lucia Cotzumalguapa, Guatemala.



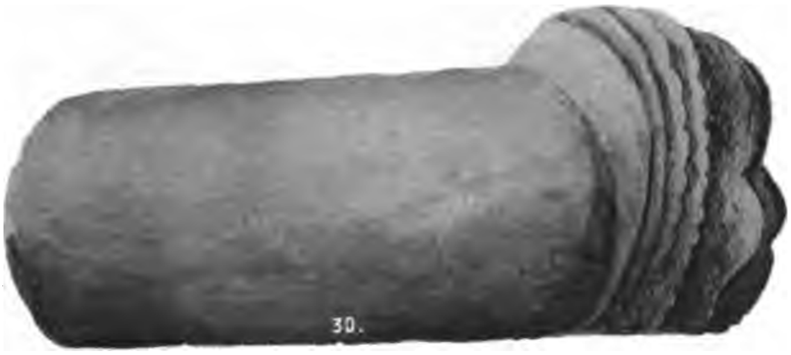




Gustav Eisen, after sketch by Dr. Berendt.
9/1882.

ARTO BRITTON & REY, S F

Sculpture of Santa Lucia Cotzumalguapa, Guatemala.



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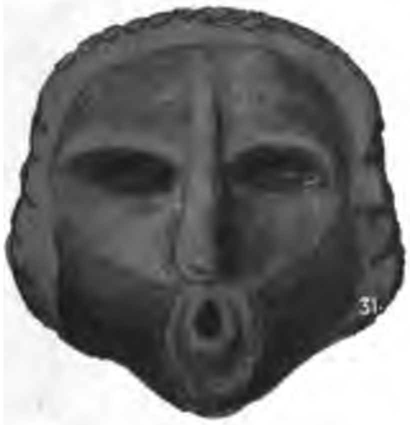

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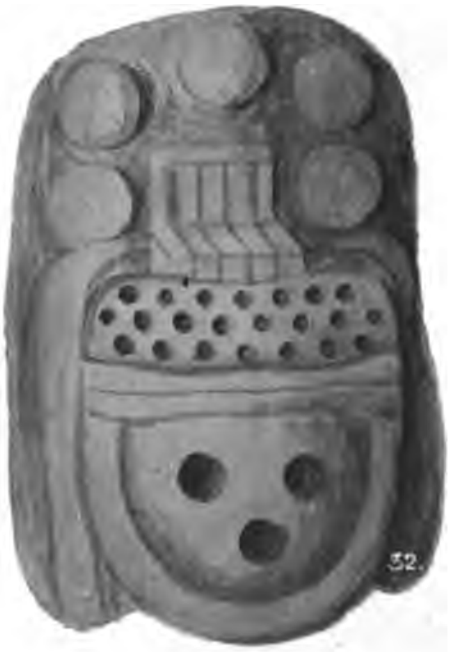

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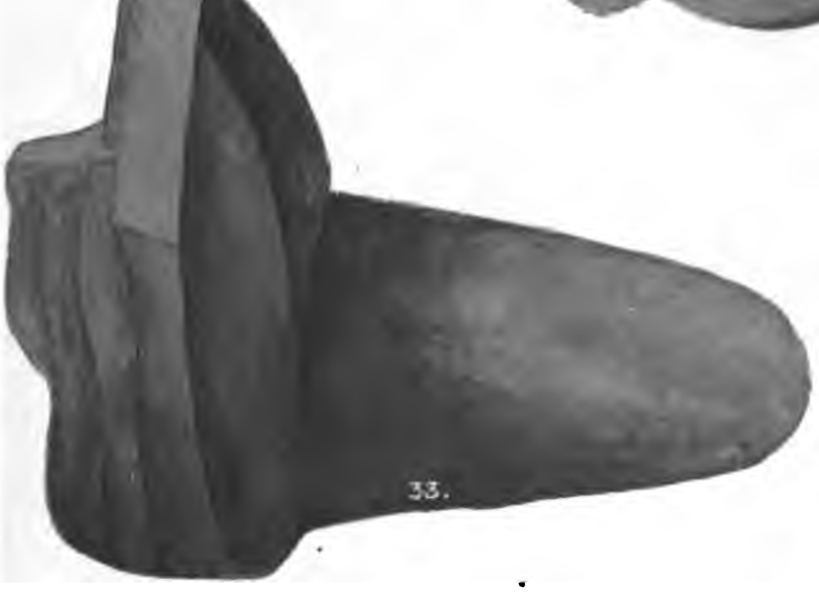

33.

Gustav Eisen, del.
4/1882.

Arto Britton & Rey, S.F.

Sculptures of Aguná, Guatemala.

MEMOIRS

OF THE

CALIFORNIA ACADEMY OF SCIENCES.

Vol. II, No. 3.

ON CALIFORNIA EUDRILIDÆ.

By GUSTAV EISEN.

SAN FRANCISCO, CAL.,
February, 1894.

ON CALIFORNIA EUDRILIDÆ.

BY GUSTAV EISEN.

The California Oligochæts, to be described below, are all related to the well-known genera Microscolex, Pontodrilus, Plutellus, etc., referred by Benham, Rosa and others to the general family of Eudrilidæ, and by Beddard to his family Cryptodrilidæ. I will not here discuss the relative merits of the respective families, as the number of species belonging to them is hardly sufficient to enable us to as yet come to any definite conclusion. For the present, at least, I retain these genera in the family of Eudrilidæ. But I must concede that this family, as defined by the above investigators, contains two distinct main types—one represented by Eudrilus and the other by Microscolex—and a separation in families should be made in reference to them, though I am not prepared to make the separation as wide as Beddard has done. Our California species ally themselves to the Microscolex group, and especially to Microscolex and Plutellus. A species of Pontodrilus was found too late to be included. I believe this family may be conveniently divided into several subfamilies based upon the openings of the spermducts, prostates, penial sacs, as well as upon the location of the nephridio-pores. Our California forms may thus be grouped as follows:

PONTODRILINI.

The eight setæ are separate though in four couples on every somite.

Clitellum complete.

Male pore in somite xviii.

Nephridia—mega-nephridia only—commence posteriorly to somite xiii; the pores are in line with setæ 2', not alternating in position.

The prostate receives the spermduct previous to its entering the male pore.

No gizzard, no typhlosole, no subneural vessel. PONTODRILUS E. P., 1881.
PHOTODRILUS Girard, 1887.

MICROSCOLECINI.

Eight setæ separate in four couples; the setæ of the inner couples not always parallel.

Clitellum complete.

Male pore in somite xvii.

The prostate receives the spermduct previous to its entering the male pore; or opens separately in the same somite.

The nephridia commence anterior to somite v; the nephridia in line with one of the setæ 3 or 4. The first few anterior pores may open in front of a different setæ from the posterior ones.

No gizzard, no typhlosole, no subneural vessel. RHODODRILUS Beddard, 1889.
MICROSCOLEX Rosa, 1887.
DELTANIA Eisen, 1893.

PLUTELLINI.

Setæ eight, in couples or equidistant.

Clitellum perfect or imperfect.

Male pores in xviii.

The prostate either receives the spermduct or it opens separately, but in the same pore.

The nephridio-pores show a systematic alternation in position either in front of or outside of the setæ.

A gizzard; a small typhlosole may be present PLUTELLUS Perrier, 1873.
ARGILOPHILUS Eisen, 1893.

The genera related to Microscolex may be arranged as follows:

I. Male pore in somite xviii. Nephridia commences posterior to somite xiii.
PONTODRILUS and PHOTODRILUS, etc.
II. Male pore in somite xvii. Nephridia commences in the anterior somites ii to v.
  a. Spermducts open independently of the prostates. RHODODRILUS.
  Sp.: *minutus; novæ-zelandiæ.*
  b. Spermducts open in the prostate, close to the body-wall.
    1. The setæ of the inner couples (setæ 1 and 2) in the vicinity of the clitellum are parallel with each other and do not converge toward any one of the genital pores. Nephridia commence in ii to iv. MICROSCOLEX.
    Sp.: *modestus; algeriensis.*
    2. The setæ of the inner couples (setæ 1 and 2) in the vicinity of the clitellum converge toward one or both of the genital pores. Nephridia commence in somite ii to v. DELTANIA.
    Sp.: *elegans: Troyeri; Benhami; Poultoni; dubia.*

DELTANIA.

Deltania Eisen, Zoe, iv, 250, October, 1893.

Prostomium encroaches on somite i. Eight setæ in four couples ventral and lateral, beginning in somite ii. The setæ of the inner couples in the genital region converging toward the male pore. The setæ of the outer couples are further apart than those of the inner couples. There are a buccal cavity, pharynx, œsophagus and sacculated intestine, but no gizzard, thyphlosole, or œsophageal pouches. Clitellum, which is perfect, contains three large somites and two outside smaller ones, extending from xiii to xvii. No dorsal grooves. Testes in x and xi, free. Sperm-sacs present, free. Spermatheca present or absent, variable in position and shape. Ovary one pair in xiii. Oviduct one pair in xiv. Two pair of ciliated rosettes in x and xi. Spermducts open in xvii together with a large prostate which is placed parallel to the segmental grooves. The spermducts join the muscular part of the prostate at the point where it enters the body-wall. The glandular part of the prostate consists of two layers of cells. Penial setæ open in the same duct as the prostate.

The dorsal vessel with three pair of lateral hearts in x, xi and xii. No subneural vessel. Only very few blood vessels on the nephridia.

Nephridia are of two slightly different kinds. Those in the first few anterior somites, commencing in somite ii, open in front of and a little interior to the 4th seta, while those posterior to the former open in front of and a little lateral to the 3d seta. The nephridia begin generally in ii, rarely in v. All nephridia furnished with a large terminal bladder which in the posterior nephridia develop a cœcal prolongation.

Small, transparent-glassy, more or less colorless worms with orange colored clitellum, and living in moist, especially sandy soil.

Systematic position. Under the genus Deltania I group all species which would otherwise be referred to Microscolex Rosa, but which agree in having a deltoid arrangement of the ventral setæ surrounding the generative and especially the male pores. With this character I believe a closer investigation of the species of Microscolex will join others, principally in regard to the nephridia which have not been sufficiently studied, probably on account of the scarcity of specimens for research.

Among species which must be referred to the genus besides those described below are *Microscolex dubius* of Rosa and *Eudrilus dubius* of Fletcher. I will first refer to the latter. Fletcher's description is sufficiently minute to allow us with certainty to refer it to the genus, but the details are wanting to such an extent, that it is difficult to understand its further relationship. There are three points in the description which are of special interest.

1. Absence of spermathecæ.
2. The beginning of the nephridia in v.
3. The junction of the spermduct and the prostate half-way between the glandular part and the body-wall.

As to the first of these the spermathecæ may be really wanting or it may have a substitute similar to the one found in *Deltania elegans* as described below. At any rate this character brings the species *Eudrilus dubius* close to *Deltania elegans* as well as to Beddard's *Microscolex Poultoni*.

The beginning of the nephridia in somite v brings *E. dubius* close to Beddard's species but separates it distinctly from *Deltania elegans* in which the nephridia commence in ii, as will be shown below.

The third character requires to be reaffirmed and described more in detail. The joining of the spermduct and the prostate is always of the utmost importance and interest and a mere general statement will not suffice for properly characterizing a species, especially when the group is little known.

Rosa at first considered *E. dubius* to be identical with his *Microscolex modestus*, but a later investigation of new material convinced him of the distinct character of the species and he then describes both as two different species of Microscolex. It must therefore be considered certain that the deltoid arrangement of the ventral setæ does not occur in *Microscolex modestus*. In regard to the respective species of *E. dubius* and *M. dubius* described by Rosa and Fletcher, I am not fully persuaded that both actually belong to the same species, and I believe that nothing short of an actual comparison of the specimens can decide if they do so.

Beddard has at two different times described species of the genus Microscolex, but which differ from each other in several important points. *Microscolex novæ-zelandiæ* resembles the old genus Rhododrilus in the independent opening of the spermduct. Instead of referring the above species to Microscolex, and merge Rhododrilus in the latter genus, I consider it more proper and convenient to retain Rhododrilus and refer *M. novæ-zelandiæ* to it, as the independent opening of the spermduct appears to me of sufficient importance to be considered a generic character. Another species, *Microscolex algeriensis*, also described by Beddard, can, I believe, best be retained in the genus Microscolex, as it evidently possesses the setæ parallel throughout the ventral side of the clitellum.

Microscolex Poultoni however is probably a true Deltania and Beddard's excellent description leaves no important characters in doubt.

In his description of *Microscolex Poultoni*, Beddard refers especially to the deltoid arrangement of the setæ in the clitellial somites. He says: "From segment xix backward and from segment xiii forward, the distance between the two ventral setæ of each side gradually increases."

Distribution and habitat. The species of the genus Deltania described below are undoubtedly natives of the Pacific Coast of North America, and more particularly of California. The species are found not only in the Golden Gate Park of San Francisco, where they might have been introduced, but also in localities distant from gardens, and in which no cultivation has ever taken place. Thus I have species from Berkeley, Santa Rosa, Lake Chabot, Mount Diablo, etc. Moreover, since this paper was finished in MS., I have found species of Deltania in localities so far from civilization that there can be no doubt as to the native habitat. I refer to species found in the high mountains of the Cape region (in the vicinity of Cape San Lucas) of Baja California, at an altitude of 4,000 feet, in almost inaccessible localities. A species has also been found in a gulch or river-bed at Ensenada, Baja California, thus proving the extensive territory over which the genus extends. The description of these species must be deferred to another paper.

As regards *Deltania dubia* (*?Eudrilus dubius* Fletcher) and *Deltania Poultoni* (*Microscolex Poultoni*, Beddard) it may be possible that the former, at least, is an introduction from abroad. The locality where the latter is found shows the genus to possess a wide neotropic extension.

While it is thus certain that species of Deltania are natives of the new world and the Atlantic islands, and especially of the Pacific Coast of North America and Mexico, the distribution of Microscolex must yet remain undecided. Whether it was imported from the Argentine Republic to the Mediterranean region, or vice versa, must remain an open question, though the finding of two species in the Mediterranean countries seems to point to the probability of that region being its real habitat.

Species. Of the genus Deltania, California now possesses at least three species with the very great probability of a discovery of new species, as soon as a wider area may have been explored. All the species appear very sensitive to dryness and heat and disappear with the first warm and dry weather, hence the difficulty of finding them except at their proper season which appears to be limited to February to April in the vicinity of San Francisco. The species in Baja California were found in September and October.

Deltania elegans.

Figs. 1–20, 49–58.

Deltania elegans Eisen, Zoe, iv, 248, October, 1893.

Size about 2 to 4 inches by from $\frac{1}{16}$ to $\frac{1}{8}$ inch wide. Septal glands very small, the posterior one the smallest. Spermathecæ very pellucid, minute, and irregular in their position both as regards somite and the place in the somite, but generally opening between viii and ix. Sperm-sacs comparatively small, deeply lobed, one pair in xi and one in xii. Prostate is at the top helix-like folded. Penial papillæ prominent, with two or more penial setæ in each sac.

The worm is very pale, glassy, semi-transparent with reddish-orange clitellum, and with the dorsal vessel showing prominently through the body-wall. It is very delicate, succumbs readily to heat and can only with difficulty be kept alive. It is the largest of the species belonging to this genus as far as known.

Habitat. *Deltania elegans* is so far only found around San Francisco, California, and at Santa Rosa and Mount Diablo, especially under decaying manure in natural hollows in the Golden Gate Park. It is common immediately north of Strawberry Hill in the sandy hollow where rain water collects and keeps the soil sufficiently moist. The worm is not found in the water, but at the water's edge, the water, however, being only temporary during the rainy season. A few specimens also found in Berkeley along the creek. In the locality in Golden Gate Park the worms congregate in large masses, always in the sandy soil. At Santa Rosa and Mount Diablo I found only few specimens, the season being at my visit in May far advanced and the soil was drying fast. Mature in April and May.

DETAILED DESCRIPTION.

Exterior characteristics. The worm varies considerably in size, but averages about three inches in length, by a width of from two to three lines, tapering considerably towards the tail. The color is pale flesh, with a bluish cast, and quite transparent, glassy, with a yellowish clitellum. Altogether, the exterior appearance of the worm is one of great delicacy, greatly heightened by its semi-transparency.

The cephalic prostomium is prominent, and divides the peristomium about ¾ of its width (fig. 3). This, the first somite, is wider than any of the following. Somites ii and iii are next in size, and about equal in width. Somites iv to xi are smaller, about equal in width, slightly decreasing backward. Somites xii and xiii are smaller than any of the other anterior somites, and of about the same respective width (fig. 2). No dorsal pores.

The clitellum (figs. 2 and 15) commences with somite xiv, though xiii is generally somewhat thickened. The clitellial somites xiv, xv and xvi are very wide, about as wide as somites ii and iii, and of the same size. Somite xvii is much smaller. This somite carries the male pores and papillæ (fig. 15). These are situated in the posterior part of the somite, almost on the edge of the intersegmental groove (fig. 15). The papillæ are slightly raised around the opening of the sac in the penial setæ. The papillæ are situate close together very near the median line of the body, a short distance only from the ventral ganglion. The papilla is oblong, sigmoid, with a pore for the setæ at inner end. Between it and the intersegmental groove is seen the slit in which open the prostate and the spermduct. It is situated slightly to the outside of the penial papilla (fig. 14).

The oviducal pores are in the anterior part of xiv, generally in a depression anterior to and more ventrally located than the inner couple of setæ. Spermathecal pores are variable, not perceptible. The nephridio-pores are in front of the third setæ, while the three anterior pepto-nephridio-pores are in front of the fourth setæ (fig 2). Clitellum is conspicious, occupying somites xiv to xvii, encroaching slightly on xiii (fig. 2 and 15).

In viewing the caudal end of the live worm a number of irregular white spots are seen in mature specimens. These are rows of mature ova which agglomerate there sometimes in large quantities. How they finally find their way through the oviduct is not readily explained..

Setæ (figs. 2 and 4). As usual the setæ begin in somite ii. All except those in the penial sacs, are sigmoid and arranged in couples of two, eight in each somite. The ventral setæ are about ⅓ closer than the lateral ones. Thus if we consider the distance between the inner and outer couples to be 50, that between the setæ of the outer couple is 30, that between the setæ of the inner couple 22, that between the inner couples 40. This being the distance in somite xxvii, where it may be said to be normal. In the region of the clitellum, and posterior to it, the inner setæ are unequally distant in the respective somites. Thus we may consider the inner setæ 1 and 2, to have the normal distance from each other in somites xii to xxvii. From these two somites the setæ in the inner couples converge toward somite xviii in which the setæ are about ⅓ as far apart as in xii and xxviii. In xvii the setæ of the inner couples are wanting.

The innermost or row No. 1, forms a continuous line from one end of the body to the other, while the row No. 2, forms an angle with somites xvii and xviii at the apex. The setæ in rows 3 and 4 are parallel and normal. The seta 1 in xviii is present (pl. xii, fig. 4).

This arrangement of the setæ appears very constant, and is characteristic of the species, the details being somewhat different in the other species of the genus, while the general characteristics are the same. The normal setæ (fig. 16) of the clitellum are not smaller than those of other parts of the body. The penial setæ are, however, very much the largest.

Penial setæ (fig. 17). The two pairs of sacs containing the penial setæ are situated in front of the spermiducal pore in somite xvii. They open immediately in front of that pore, in a slit, at either end of which is situated a pore, each pore being the outlet for the respective fork of the penial sac. The two sacs are connected at the upper margin as usual by arciform muscles. Each sac contains not less than two, and sometimes three or four setæ, straight or slightly curved, but not sigmoid. The setæ vary considerably as regards shape, but resemble each other in not being sculptured, and are only marked by rings. The penial sac reaches to the upper part of the muscular part of the prostate.

INTERIOR CHARACTERS.

The *Septa* begin between somites iv and v. Those between vii and viii, and following as far back as somite xiv, are slightly thickened, all, however, being of the ame general thickness,

The *body wall* contains the usual layers. The hypodermis is slightly thinner than the circular muscular layer, and this again is thinner than the longitudinal muscular layer. The clitellum is perfect, but somewhat thicker on the upper part. The glandular layer is very thick, being about ten times thicker than the two muscular layers combined. The longitudinal fibres are nowhere arranged in such feather-like bunches as in Lumbricus, but much more irregular, with a faint tendency to feather-like bunching. This is the rule both in the clitellum and elsewhere. This stratum of longitudinal fibres is, as usual, interrupted in four places by the setal grooves, though there are also fibres between the setæ. In the center, between these grooves, the layer is thickest, from there gradually tapering towards the setæ. The under side, or the ventral part, of the layer is somewhat thicker than the dorsal part.

The clitellar glands are less regularly paired than in Lumbricus though the general arrangement is that of two or three rows of glandular cells together. The clitellum is very thick and developed all around the body.

Alimentary canal (fig. 1). The buccal cavity is eversible to a remarkable degree, so much so that it is often projected like a large sac or bladder, covering more or less perfectly the prostomium and part of the peristomium. Its walls are very thin and transparent. The pharynx commences with the prostomium and covers somites i, ii, iii, but is only dorsally developed. It is much and irregularly folded, the sinuses being sac-like and not parallel, the largest ones being in somites ii and iii. The muscles of the pharnyx are thickly covered with salivary glands. Superiorly these glands project along the under side of the muscular bands, which extend backward, thus forming three rows of parallel projections tapering from base to apex. The anterior of these salivary glandular masses is the largest, the third, or the most posterior one, the shortest (fig 6). The posterior half of the salivary glandular mass forms one single projection equal to all the anterior ones together. This gland is connected with and partially rests on two muscular bands attached to the body-wall between somites vii and viii.

Œsophagus commences between iii and iv, extending backward to somite xvi, being slightly differentiated in xiv, xv, and part of xvi, as a tubular intestine (fig. 1). Œsophagus is much sacculated, first rising upward and forming a sigmoid plexus in somite vii, after which it lowers itself somewhat in viii and then extends gradually backward to the sacculated intestine, at the same time gradually diminishing in size. The tubular part in xv or between xv and xvi is the narrowest part of the œsophagus. The glandular epithelium of the œsophagus is very narrow in the anterior somites, or those in front of the clitellum, and the blood sinuses in them are narrow. In the anterior part of the clitellum the epithelial villi become greatly elongated with increased blood supply, while in the central part of the clitellum these blood sinuses become very large, occupying the largest part of the epithelial lobes. The nuclei in those epethelial cells are everywhere round.

The *sacculated intestine*, fig. 1, *s. i.*, commences in xvi, is generally about four or five times wider than the tubular intestine. It does not increase gradually, but at once, in which it differs from the corresponding organ of the two other species described here.

Septal glands (fig. 1). The septal glands of the œsophagus are found paired in somites vi, vii, viii and ix. They are all comparatively small and very thin and flat. The posterior ones are smaller, but the difference between the glands is not so great as for instance in some species of Ocnerodrilus, or as in *Deltania Troyeri.* They are more nearly of the same size, and they extend all around the œsophagus and are more or less divided in several separate lobes. We can, however, always distinguish one pair in each somite connected with the septum below the alimentary canal, extending upward with its free upper lobes, which do not connect.

Nephridia (figs. 19 and 20). The nephridia commence in somite ii, and are found in all posterior somites. The three anterior nephridia—in ii, iii and iv—are slightly different as to size and outward form, and may be considered as a kind of pepto-nephridia. They open, also, differently from other nephridia, their pores being in front of and a little interior (nearer the ventral ganglion) to seta 4, while all other nephridia open in front of and interior to the third seta. The nephridiopores of the clitellum are considerably larger than the pores in the other somites, and appear like large, transparent discs when viewed from the outside. All nephridia possess a vesicle or bladder next to the body-wall. A small collar of tubular cells surround the nephridio-pore. The vesicle is smaller in the anterior pepto-nephridia, gradually increasing in size backward, being largest in the post-clitellar nephridia, where it is several times larger than in the pepto-nephridia. In the three pairs of pepto-nephridia, the vesicles are almost circular, and of the same size in the three nephridia. That of the first common nephridium in somite v is of about the same size as the pepto-nephridial vesicles, but from this on the bladders increase gradually, but slowly, in size to the end of the clitellum. But in somite xviii and following to the end of the body, the vesicles are much larger, about twice as large as those in the clitellum. Thus the nephridio-vesicles in the clitellum are about three to four times shorter than the tubular part, while the post-clitellar vesicles are half, or more than half, as long as the tubular part or duct, when ordinarily folded. In the pepto-nephridia, the vesicle is about five times shorter than the folded tube, and the tubular duct extends more backward than in the other nephridia—especially so in the first nephridium—encroaching on the next posterior somite, reaching diagonally across the somite, while all the other nephridia run parallel with the intersegmental grooves. This diagonal position of the nephridia is, however, not always constant, except in the most anterior nephridium. The vesicle in the posterior nephridia consists of two more or less distinct lobes, the posterior one (to the duct), which is more rounded and bladder-like, forming a cœcum, and the anterior, which is elongated or deltoid. This difference is more pronounced in the posterior than in the anterior nephridia, most so in the nephridium in sonite xviii, which nephridium is generally the largest of all. From this somite the nephridia diminish somewhat in size, both anteriorly and posteriorly. The posterior margin of the vesicle is considerably lobed, and in general outline convex. The anterior margin is convex-deltoid, with the apex at the exterior pore.

The single duct from the vesicle leaves the vesicle in a different manner in the respective nephridia. In the pepto-nephridia it ascends from the center of the vesicle; in the anteclitellar vesicles it leaves from the apex of the deltoid longer part of the vesicle, while in the postclitellar nephridia it leaves from the side of the vesicle below the apex. The inner structure of the nephridia corresponds almost exactly with that of the nephridium of Argilophilus, which genus, however, does not possess a vesicle. With this exception, the nephridia of the two genera might be considered as almost identical. The most characteristic feature is that the short single duct from the nephridio-stome after joining the nephridial body, does not enter it as a single tube, but as a spongy duct full of irregular and connecting ductules, which later on join into one larger branching canal, the ductules, or arms of which enclose the two regular underneath-lying ducts. At the inner bend of the duct the ductules disappear and the returning lobe contains three main canals, one of which is ciliated. This arrangement reminds us greatly of the one observed in certain leeches and described by Bourne. The vesicles consist of an outer muscular layer, which extends all around the bladder, and from it, along the duct through the clitellum or body-wall, to the exterior pore. Between it and the cœcal epithelium there is a continuous row of connecting chambers probably analogous with the ductules of the ducts. This epithelium is furnished with some few blood-vessels. The duct from the bladder to the nephridio-pore is not otherwise differentiated, the glandular cells of the clitellum joining directly on the muscular duct. Before reaching the pore but while in the body-wall, the duct is enlarged, forming a small pear-shaped urinary bladder, which again opens into a narrow duct surrounded by a row of long tubular cells, which open directly into the duct. These cells form a veritable collar, the upper cells lining the inner surface of the nephridio-pore (fig. 49). This in the clitellar nephridia. In the nephridia posterior to the clittellum, the long tube between the vesicle and the pore is entirely wanting, the bladder connecting directly with the collar of tubular cells (fig. 50). The tubules, or vacuols, in the vesicle collect into at least two tubes, which run downward between the muscular and glandular layers of the vesicle and apparently open on either side at the beginning of the collar at the nephridio-pore (figs. 49 and 50). The secretion from this glandular layer of the bladder may be of such nature as to facilitate the ejection of coarse matter such as calculi which are found often in enormous quantities in the vesicle or seen as just ejected through the pores. The single duct which leads from the bladder to the nephridial body proper or the folded canals, apparently does not connect directly with the ductules or vacuols of the bladder, but opens directly into the large central chamber of the bladder, which again connects directly with the collar of the nephridio-pore. For a more detailed account of the canals of the nephridia in these two genera see the description of next genus, Argilophilus. Below the nephridial collar in *Deltania elegans* is found a large branching body, probably a ganglion. It sends out branches to the nephridial collar, though in my sections I have not seen their actual connection with the collar. In fig. 50*b*., the section is made through the junction of the nephridio-vesicle and the collar, and the ganglion (*n. gl.*) below is small, not yet branched. In fig. 50*c*, the section is made close to the pore where the ganglion (*n. gl.*) is branched. These branches always extend towards the collar, never the other way. Both these sections from which the drawings were made are not quite in right angle to the longitudinal muscular layer, but slightly slanting.

The nephridio-stome is rather large, but very transparent and quite difficult to detect. It is flat, rosette-like and placed half-way between setæ 1 and 2. The duct descending from it is remarkably thin, straight and never winding. The nephridio-stome is normally situated, piercing the anterior septum as usual. There is no central cell and nucleus larger than the other, but several smaller cell nuclei are visible in the center below the large marginal cells, which are about 16 to 18 in number and as usual placed in a crescent. Between these cells and the real margin of the lip there is a row of smaller cells and nuclei, the latter being slightly lower than the inner large nuclei, but sufficiently situated in the same plane to be seen at the same time.

Testes consist of two pairs of small bodies, as usually situated in somites x and xi, attached to the septum close to the body-wall in the anterior part of the somite. They are deeply lobed and the lobes are very narrow, parallel and generally three or four in number. The testes are free, not enclosed in the sperm-sacs.

Sperm-sacs (figs. 5 and 6). There are two pair of sperm-sacs, one pair in somite xi and one pair in xii, attached to the anterior septum in the somite, rather high up, but below the œsophagus. The four sperm-sacs are of about the same size, comparatively small, and deeply lobed very much like the posterior sperm-sac in *Ocnerodrilus Beddardi*, etc., none of the lobes being very much larger than the other. It must be remarked that the sperm-sacs are not situated in the same somites as the testes, somite x possessing testes, but no sperm-sacs, and somite xii possessing sperm-sacs, but no testes. The respective sperm-sacs are not connected with each other and there is no median sperm pouch. The trabecula or muscular divisions of the sperm-sacs are numerous and the chambers enclosed by them are comparatively small.

Spermducts and rosettes (figs. 7, 8, 11). There are two pair of ciliated rosettes, one in xi and one in xii, as usual. They are very large and folded, deeply crumpled and very prominent, occupying about ¼ of the somite. The funnels are wide, with a slight posterior swelling. The spermducts run backward and sideways, connect in xii, and continue to somite xvii, where they leave the body-wall, ascend slightly and connect into one single duct, which opens out jointly with the prostate, in the posterior part of the somite. The duct does not enter the prostate, but both open jointly in one slit, running parallel to the intersegmental furrow. The spermduct is throughout of the same size, only widening out just previous to entering the rosette. The lower descending part of the duct, between the spermiducal pore and the bend where it starts forward, is slightly narrower than the anterior part.

Prostate (fig. 8). There is one pair of prostates of rather prominent size extending parallel with the intersegmental groove reaching almost across the somite. The shape of the prostate resembles at the top somewhat a curved feather, the inner apex being helix-like, curving backwards. This form appears quite constant and while I found the length and the width of the prostate to vary, I never found one, which did not show the helix-like, convolution. The thickness of the prostate varies considerably. In some specimens it was almost twice as thick as in others, the increased thickness being caused by a gradual widening toward the inner apex. In some specimens the prostate was longer, more slender and its longitudinal sides almost parallel, but the convolution was generally always thickened. In most instances the convolution could be considerably straightened out by a pushing with a needle, but it would when released assume its natural helix-like form. The spermduct connects with the muscular part of the prostate in the muscular layer of the body-wall. The sac containing the penial setæ is situated immediately anterior to the prostate and somewhat closer to the ventral ganglion in line with the regular setæ, but opens in the same pore with the prostate and spermduct. (Figs. 8, 51, 52, 53.)

A cross section of the glandular part of the prostate shows that it is composed of two layers of cells, the outside one containing large cells of flask-like shape, the inner are narrower rectangular cells. The contents of both layers resemble each other greatly and are difficult to discern. Both layers of the prostate contain numerous blood vessels arranged like radii in a circle, penetrating both of the cellular layers. But the inner layer is seen to also possess a vascular system of its own with many smaller vessels similarly arranged. These vessels are generally wider at the periphery of the prostate and narrow toward the center, many if not all collecting in a network of capillaries spreading on the inner surface of the prostate (figs. 55 and 56). Otherwise these vessels do not anastomose. All these vessels are fed by a branch from the ventral vessel of the body, which divides on the prostate into two or three large branches which again fork toward the apex of the prostate in many smaller ones, as in *Deltania Troyeri* (fig. 45).

This junction of the various male organs is affected in this manner. The two spermducts run jointly on the top of the inner longitudinal muscular layer of the body-wall. When reaching the lower or muscular part of the prostate they turn and run parallel to it. Immediately before reaching the place where the prostate enters the wall, the two spermducts fuse into one duct, the lumen of which then is wider than the adjoining part of the prostate. This duct joins the prostate in the longitudinal muscular layer of the body-wall. After reaching the transverse muscular layer this duct joins the pore of the penial setæ (figs. 51, 52, 53).

Spermatheca (fig. 13). The spermathecæ consist of very minute bodies, pear-shaped in outline, and of extremely delicate structure, without any differentiation of the wall in a muscular and glandular layer. In size, the spermatheca is not much, if any, larger than one-half the width of the somite, when contracted in alcohol. But the most peculiar feature of this organ is that it is variable in number and position.

In one specimen I found only one spermatheca, situated in the center of the ventral line, between somites ix and x, but in x. Another specimen had two spermathecæ, one in ix/x, another on the left side, between x and xi. Another had two spermathecæ betweeen x and xi, one on each side. Another had two spermathecæ between ix and x, one in center of median line, and one on the right side, always attached to the intersegmental wall. This arrangement and variability of the spermathecæ reminds us of the spermathecæ in Microchæta, where the number varies on either side; but in other respects there is no similarity between the two. The exterior spermathecal pores are not conspicuous, and not perceptible when viewing the outside of the body, mounted, for instance, in glycerine. As will be seen, the spermatheca in this species differs very much from those in *Deltania Troyeri* and *Benhami*, in which two species this organ is constant, and furnished with two diverticula each. The spermatheca in *Deltania elegans* resembles greatly in structure a sperm-sac, from which it only differs in size and in position. It reminds me greatly of the peculiar organ described by me in *Ocnerodrilus occidentalis*, where, apparently, the posterior testes have become modified, and assumed the function of spermathecæ, with a distinct and ciliated duct perforating the body-wall.

The *spermatozoa* are always found agglomerated in sphærical masses in the spermatheca, hardly regular enough to be designated as spermatophores. The tails are long, either extending straight out, or arranged screw-like in the same direction around the sperm-ball. These balls vary greatly in size, some being twice as large as others, but they are always round and apparently globular (fig. 13).

Ovary and Oviduct (fig. 9). As usual the ovary is found in xiii. It offers no great peculiarities. It is rather deeply lobed and very large. The oviduct opens in xiv, with its funnel in xiii. The oviducal funnel is very thick, substantial and round, with a circular and very regular outline. The figures (5 and 9) give correctly its outline, but the depressed folds have been too distinctly marked. There is no ovisac, and the ovary and oviducts are entirely free.

Blood vessels. The dorsal vessel emits three pair of hearts in x, xi, xii, and the ventral vessel is forked between somites ix and x. The blood is yellowish-red, more decidedly yellow than red. There are but few blood vessels on the nephridio-tubes and none on the nephridio-vesicle.

The *ventral* nerve-cord is considerably wider in the posterior part of the somites where it emits the customary pair of nerve fibers. In the anterior part where the single septal nerve pair is emitted, the nerve-cord is quite narrow. In *Deltania Troyeri* the nerve-cord is quite uniform without any nodular enlargements, as wide at the anterior as at the posterior end of the somite. The brain is narrow, slightly curved and the posterior sinus shallow. It is situated in somite ii (fig. 6).

Deltania Troyeri.

Figs. 21 to 39.

Deltania Troyeri Eisen, Zoe, iv, 251, October, 1893.

Size about 1¼ inch by ½ line. Septal glands comparatively large, the one in vi the largest. One pair of large, opaque spermatheca, furnished with one pair of diverticula, which are about ⅓ or more longer than the spermatheca proper. Spermsacs in x and xi, not lobed. One developed seta in each sac of penial setæ. Prostate is tubular, not helix-like, with the top either straight or bent at right angle, projecting backward. The exterior penial papillæ not as prominent as in the preceding species. The inner couples of setæ are further apart than in the following species.

Habitat. This species was first brought to my attention by Professor Carlos Troyer, of San Francisco, who found it, together with the preceding species, in the Golden Gate Park, in San Francisco, immediately north of Strawberry Hill. It occurred there in sandy depressions, where the rain and drainage water had moistened the soil in March and April. As the soil dried up the worms disappeared. The worm is very scarce at any time, and not one specimen is found to every hundred of *Deltania elegans*.

Exterior characteristics. Exteriorly this species is characterized at once from *Deltania elegans* by being very much smaller, as much so as an Enchytræus is smaller than an average medium-sized Lumbricus. The length in the largest specimens is about two inches, when stretched to its full capacity, though the average ones hardly reach one inch. The width is less than one line at the clitellum and less than ½ line at the tail end. The first somite is much longer than any of the following. The second somite is next in size, while all the others are smaller and of very much the same proportions as in *Deltania elegans*. Thus iii, iv and v, are larger than the following, and those between v and xiii are smaller and of about the same size.

The clitellum occupies the same somites as in *Deltania elegans*, or from xiv to xvii, with the two outside somites smaller than the central ones. The body tapers towards the tail end, the last somites being somewhat larger than the others and rather obtuse.

The color is pale flesh, with a darker, yellowish clitellum. The whole body is very transparent, just as the former species, but much less so than in the following. It is a very tender worm indeed, and can only be brought home alive with great care, as the least increase of temperature is apt to kill it. In no instance did I succeed in keeping it alive more than a couple of days. In this respect, however, all the species of the genus are very much alike, and if there is any difference the larger species is the most tender.

Setæ (figs. 21, 24 and 39). The general arrangement of the setæ is similar to that of *Deltania elegans*, but the two inner setæ are much less close together, in comparison with the two outer ones, than in the latter species, but not as close by one-half as in

Deltania Benhami. In the genital region, the distance between the two inner setæ diminishes toward the male pore, almost in the same way as in *Deltania elegans*, with, however, a slight but characteristic difference. The inner or first seta in xviii is often, but not always, wanting, probably falling out when young, before its full development, as more frequently a rudimentary seta is seen in place of a fully developed one.

The first and second setæ in xix and xx are closer together than normally, but already in xxi the setæ have regained their proper distance. Again, anterior to the male pore, the setæ 1 and 2 in xi to xvi are closer than normally, those in xiv to xvi are equidistant, while those in x to xiv rapidly approach. If we thus compare with *Deltania elegans*, we find that the arrangement relatively in front and behind the male pore is reversed. While in *Deltania elegans*, the anterior setæ quickly converge, the posterior ones approach slowly. In *Deltania Troyeri*, the opposite is the case.

The shape of the setæ in the two species is very similar. Compared again with the arrangement of the setæ in *Deltania Benhami*, we find that in the present species the setæ in the ventral couples, as well as those couples themselves, are much further apart than in *Deltania Benhami*. The deltoid arrangement, also, is different in the two species, of which the figures give a better idea than any lengthy description (figs. 24, 39, 40).

The *sacs of penial setæ* (fig. 33) are found as usual in the vicinity of the male pore in xvii. There are seldom more than one seta in each sac. This seta is long, slender, almost straight, occupying the whole length of the sac. Now and then there is a rudimentary seta in the same sac, but never more than one developed seta. In *Deltania elegans* there are three or four setæ in each sac.

Alimentary canal (figs. 26 and 27). The buccal cavity extends superiorly to ii, inferiorly to v. The pharynx ends in v, and is much less developed than in *Deltania elegans*. The upper fold is, however, very large. There are one pair of long and narrow salivary glands in each of iii and iv, and one pair very large compact ones in iv. The œsophagus commences in v, and rises to a sigmoid plexus in viii. It is greatly contracted at the septa. In xv and xvi it narrows down to a tubular intestine.

The sacculated intestine commences in xvii, but attains its full width first in xix or xx. There is no gizzard, no calciferous glands nor pouches of any kind attached to the alimentary canal.

Nervous System (fig. 28). The characteristic feature of the nervous system is the even width of the ventral ganglion, the two sides being nearly parallel throughout, with almost imperceptible contractions at the septa. In *Deltania elegans* this contraction is very prominent, and the ganglion is almost twice as wide in the posterior part of the segment as in the anterior one. This characteristic appears constant. In *Deltania Benhami* the ganglion is narrowed somewhat at the septa, but the posterior part in each segment is not any wider than the anterior part.

Septal Glands (figs. 26, 27, 29). When the worm is laid open and the cavity viewed from above, it is seen that there are 4 pair of septal glands surrounding the œsophagus in somites v, vi, vii and viii. In this view the anterior gland appears the largest, and the posterior one in viii the smallest. This is, however, only an illusionary appearance, caused by the position of the glands. There is in reality not any very considerable difference in their size, as may be seen when separated and spread out. Seen in a slightly eccentric longitudinal section, the gland in vi appears the largest both above and below the œsophagus, though in some sections the lower part is not as large as the lower part of the gland in vii. The anterior gland in v is short but broad. The one in vii is larger than those in v and viii, but smaller than the one in vi. The upper part of the gland in viii is larger than the corresponding part of v, the lower part of the latter being the smallest. As will be seen, all the glands are developed, both superiorly and inferiorly, as regards the œsophagus, but the glands on either side in the somite do not connect, but only touch. There is a slight, but irregular lobing of the glands, frequently unequal on either side, as one gland may be almost entire, while the other again is furnished with three indentations. On the under side of each main gland there is a smaller lobe, almost entirely separated from the rest (fig. 29). The glands are furnished with blood from the subœsophageal longitudinal blood-vessel which projects a branch to each gland, on which it again divides in two or three parts (fig. 29). I may add that the septal glands are very large, almost filling the respective somites, and as compared with those of *Deltania elegans*, about three times as large, considering however the relative size of the two species. The glands are nearly similar to those of *Deltania Benhami*, but with more unequality as to size.

Salivary or Pharyngeal Glands (fig. 26). These glands resemble those of the preceding species, *Deltania elegans*, in general appearance. There are two very long glands behind the brain, attached on the underside of the two long muscular bands which stretch upward. The anterior one of these is the smallest and rather short, the second in order from the brain is the longest. The posterior gland, which forms the posterior projection of the pharynx, is much shorter, more compact and rounded than the corresponding gland in *Deltania elegans*. The whole mass of glands projects much less posteriorly than the glandular mass of the pharynx in that species.

Spermatheca (figs. 30, 31, 32 and 39). These organs are prominent and characteristic of the species. There is one pair in somite ix opening in the intersegmental groove between that somite and viii. The external pore is in front of the inner couple of setæ, but not interior to the setæ. The organs are thick, opaque and of the form of pointed sacs, each one with two diverticula, one on each side, which connect with the main sac close to the external pore. The outline of the sac is irregular in some places, toward the inner apex assuming the appearance of one or more warty diverticula, which, however, never assume the size of the diverticula. Of these latter there are one pair which are slender, cylindrical, of more or less irregular outline with the apex sometimes slightly wider, sometimes helix-like, turned on itself. The lower part of the spermatheca is muscular, but this muscular part is quite small, not extending above the junction with the diverticula. In general form the spermatheca resembles that of the following species, *D. Benhami*, but the outline of the main sac is less regular and the diverticula are larger, being about one-half as long as the main sac (figs. 30 to 32).

Testes. As usual there are two pair of small testes occupying somites x and xi. They differ in nothing particular from those of the other two species of the genus.

Sperm-sacs. There are two pair of sperm-sacs, one each in somites x and xi. They are long, not very opaque bodies, occupying a large part of the somite, though not filling it closely. The spermatophoric spherules are comparatively large, globular. The sperm-sacs are not greatly lobed, extend considerably in length from the dorsal to the ventral side, and are of more undecided shape than the sperm-sacs of *Deltania elegans* and *Benhami.* They are also, comparatively, much larger (principally higher) than in that species. It will be noticed that the sperm-sacs occupy somites x and xi, while in *Detania elegans, Benhami* and *dubia* they occupy somites xi and xii.

Ovary and Oviduct (figs. 35, 36, 37, 38). As might be expected the ovary is situated in xiii. It offers no characteristics of interest. There is no ovisac. The oviduct is as usual funnel-shaped, either deeply cut or folded on one side, the inner funnel in xiii, the ovipore in xiv. Close to the oviduct in xiv there is a very peculiar sac (figs. 35 *et seq.*), of the size of the oviduct or smaller. It does not open directly in the oviduct, and it has the general shape of a septal gland with many rounded lobes arranged as the petals in a rose. The epidermal covering does not closely cover the inner cells which are irregular, apparently not closely packed, of uneven size and shape, round or conical, each with a round nucleus, and grainy cell contents. This gland does not connect with the opening of the oviduct funnel, from which it is separated by the septum between xiii and xiv. There is one pair of those glands, one behind each oviduct. The gland is affixed to the posterior part of the anterior septum in xiv. A similar gland does not exist in *Deltania elegans.* As to the nature of this organ I can say nothing definite, and I hesitate to consider it as an ovisac, until a more extensive material will allow other investigations.

Spermduct and Prostate (fig. 33). As in the preceding and following species, the spermduct and prostate open in the same pore in somite xvii. The spermduct opens slightly posterior to the prostate and also more outwardly, though both organs closely join at the pore. The spermduct is quite wavy throughout its length to the ciliated rosettes, which as usual are found in x and xi, The rosettes are less folded and crenate than those in *Deltania elegans.* The prostate differs somewhat from the one in the latter species. The muscular duct is not helix-like at its upper end, either straight or bent at right angle to itself, with the distal end pointing backward, being parallel to the longitudinal axis of the body. The relative size of the prostate is in this species much larger than in *Deltania elegans*, which appears to be characteristic also with nearly all the other organs. The upper glandular part of the prostate is about three times wider than the lower muscular part. The latter is about equal in length to the penial setæ and their sacs.

Genital or exterior *male zone* (fig. 25). In somite xvii there is a pair of ventral papillæ close to the ventral ganglion, and situated in the transverse median line of the somite. In these papillæ open the penial setæ, in the place which otherwise would be occupied by the regular setæ. Between these papillæ and the ventral median line of the body, somewhat nearer to the posterior margin of the somite, are seen on either side a circular cup-shaped depression, from the center of which is spread backward a large fan-shaped branch of muscles connecting with the posterior intersegmental groove. In the center of this suctorial organ, and at the very point from which the fan-shaped muscular fascicle starts, is situated the exterior opening of the spermduct and the prostate. In the median line between the suctorial cups is a smaller triangular depression. The anterior part of the somite is raised and thicker than the posterior part, or rather there are two large anterior folds, and several smaller posterior ones in the vicinity of the male pores (fig. 25).

Deltania Benhami.

Plates xv and xvi, figs. 40–48.

Deltania Benhami Eisen, Zoe, iv, 212, October, 1893.

Size about 1 inch by $\frac{1}{16}$. The inner couples of setæ as well as the setæ in the inner couples are much closer together than in any other species. The spermatheca are large, opaque, situated in ix, and opening between ix and viii, with two diverticula, which are less than $\frac{1}{2}$ as large as the main spermathecal sac. A small species, in many respects resembling *Deltania Troyeri*, but very distinct by the above characteristics.

Habitat. I have found this worm only in a gulch or cañon at the outlet of the waterworks and dam, known as Lake Chabot, east of Alameda and San Leandro, in Alameda Co., California. The worm is very scarce and lives under damp leaves in the very top layer of the soil around the roots of trees. The exact locality is to the right of the gate which closes the reservation, down by the creek, not far from the wire fence. It occurs here alone, not mixed up with any other species, and to all appearances this species is a true native and not introduced. It is an exceedingly delicate worm, almost transparent, white, with yellowish clitellum, very impatient of being handled and can only be kept alive with great care. It is much more transparent than any of the other species.

Exterior characters. In general appearance, the worm resembles *Deltania Troyeri*, but is slightly larger in size. The second somite is much narrower than in that species, being larger than the third somite. But it is especially as regards position of the setæ that the greatest external difference exists (fig. 40). The ventral setæ in one species are much closer together than in the other species of the genus, and average about twice or three times as close as in *Deltania Troyeri*. This is a prominent and constant characteristic. The characteristic feature of the genus, which consists in the narrowing together of the ventral setæ on both sides and towards the male pore in xvii, is readily seen in this species. On account of the already very close approach of the ventral setæ of each couple, this narrowing together is, however, less perceptible in our present species, but it is still considerable and readily seen. The figure (fig. 40) will illustrate this better than any lengthy description. Not only does this approach of the setæ exist on both sides of the male pore, but it is also seen towards the spermathecal pore, though here in a smaller degree. In *Deltania Troyeri*, there is not a trace of such an increased approach of the ventral setæ towards the spermathecal pore. Another characteristic as regards the setæ is that the ventral or inner couples are much closer together than in the other two species described here, so close that the main bodies of the spermathecæ almost touch.

The spermathecal pore is situated in the intersegmental groove between viii and ix, in front of seta 1. In *Deltania Troyeri*, the spermathecal pore is in front of the corresponding seta 1, but considerably more lateral, and on account of the greater distance of the ventral couples of setæ, the spermathecæ in that species are much further apart, and do not crowd the ventral ganglion. Oviducal pore as usual in xiv. Penial setæ on papillæ in xvii, opening in the male pore. The clitellum comprises three full and wide somites, xiv, xv, xvi, and two smaller ones, xiii and xvii, as in other species.

The genital region (fig. 48) around the male papillæ is much simpler than in *Deltania Troyeri*. The two papillæ are situated much closer together, and there are no suctorial depressions with their fan-shaped arrangement of muscles. The penial setæ are very slender, sickle-like, bent at the free apex, with a narrowed and sharp point. There are a dozen or more external fibres of exceeding thinness stretching from the anterior part of somite xvii to the posterior part of xviii. These threads, however, exist only in the longitudinal groove between the papillæ, all run parallel with each other and with the long axis of the body (fig. 48). As to their nature I am not at all certain. They are apparently too thin to be muscles. The clitellum proper in this as in the preceding species ends at the papillæ or male pore. Anterior to it the clitellum consists of regular flask-like cells; posterior to it again the body-wall has assumed its regular appearance. In *Deltania Troyeri* the clitellar thickening stops just before it reaches the papillæ, but in *Deltania Benhami* it stops just as it reaches the male pore. The papillæ, however, continue to the posterior end of the somite.

The length of the species is about 1 and $1\frac{1}{4}$ inch, by $\frac{1}{16}$ to $\frac{1}{8}$ inch wide, tapering towards the caudal end. In fact the general form and size does not differ from the preceding species. In all I found some fifteen specimens, but they were, unfortunately, in poor condition when I arrived home, and the part posterier to the clitellum had already begun to decompose. The following account of the anatomy is, therefore, not as full as desirable, but enough is known to perfectly characterize the species. There are four pair of septal glands in v, vi, vii and viii. The glands, as far as I can judge from dissections only, are of almost equal size, somewhat longer there than in *Deltania Troyeri*. They are equally developed on the lower and upper side of the œsophagus. The alimentary canal offers no great peculiarities. The specimens were all very much stretched, and I am not certain if the form of the œsophagus will prove constant. However, the contractions at the septa were much smaller than in any other species. The œsophagus from somite ix narrowed down toward somite xii, here it began to gradually increase in width, but the sacculated intestine begins evidently first in xvii, increasing in width gradually backwards until it reaches the region between xxvii and xxxv, where it suddenly narrows and continues as narrow to the end of the body.

Spermatheca (figs. 42 and 43). There is one pair in ix, opening between viii and ix, of the same general appearance as in *Deltania Troyeri* with minor characteristic details. The main sac is ovoid and somewhat lunate, pointed, with very smooth outline and with no trace of warty excrescences. There are two diverticula affixed halfway between the base and the glandular part. They are much smaller than those of *Deltania Troyeri*, being less than one-third as long as the main spermatheca, while in *Deltania Troyeri* the diverticula are one-half or more as long as the main spermatheca, and affixed to the muscular part close to the base. The spermathecæ open in front of the 1st setæ and are situated much closer together than those in *D. Troyeri*. The opaqueness of the spermatheca is the same as in the latter species. There is, however, a decided difference in the location of the spermatheca. In *D. Troyeri* they are situated so far apart that they do not touch the ventral ganglion. In *D. Benhami*, however, they crowd it, this approach being caused partly by the closer proximity of the ventral or inner couple of setæ, partly by the situation of the spermathecal pores which in our present form are more ventral to the setæ.

The sperm-sacs (fig. 41) are of a very characteristic form. They are larger in proportion than those of *D. elegans*, but not quite as large as in *D. Troyeri*. There are two pair, one each in ix and xii, and they do not connect with each other. Each one consists of a very large flesh-like lobe, at the base of which are seen half a dozen smaller and globular sacs, all connected at the place of adherence to the anterior septum. These different lobes, the large one as well as the small ones, are full of rounded, oblong or irregular spermatophoric sphærules. The sperm-sacs do not by far fill the somites. The form of the sperm-sacs varies to some extent, but the main character is the same in all, a large, rounded or flask-like lobe, at the base of which are several smaller ones.

Spermduct and *ciliated rosettes* as in *D. Troyeri*. The *prostate* offers the characteristic of having the lower part of the glandular sac considerably swollen, conical and gradually diminishing in size towards the apex, which again is slightly enlarged like a knob. There is only one long slightly bent or almost straight seta in each of the penial seta-sacs, both setæ opening on a small papilla, and which as far as I can see more resembles that of *D. Troyeri* than *D. elegans*. The blood is very pale yellow, paler even than in the other species. There are three strongly pulsating hearts in somites x, xi and xii, connecting the dorsal and ventral vessels. There are also connections between those two vessels in ix, x and xiii as in the other species, but those connections consist of regular secondary vessels narrow and tubular, and in no way resembling hearts. There is no subneural vessel. The ventral vessel is divided in somite vi, and in the anterior six somites there is a heavy capillary system connecting the ventral and dorsal vessels.

In the following I have endeavored to give a comparative table of the species which I refer to *Deltania*. As far as concerns those species which I have not myself investigated the table must be considered tentative, especially so in regard to the character of *D. dubia*, the description of which by Fletcher is somewhat insufficient. I need here hardly add that *Deltania Poultoni* is the species described from Maderia by Beddard as *Microscolex poultoni*. The description given for D. *dubia* is taken from Rosa's description of *Microscolex dubius* Fletcher, and not from Fletcher's own.

DELTANIA.

	D. elegans n. sp.	*D. Troyeri* n. sp.	*D. Benhami* n. sp.	*D. Poultoni* Bedd.	*D. dubia* **Rosa.**
Septal glands in	vi, vii, viii, ix.	v, vi, vii, viii.	v, vi, vii, viii.	Not present.	
Sperm-sacs in	xi, xii.	x, xi.	xi, xii.	xi, xii.	**xi, xii.**
Spermatheca	Very small and pellucid. No diverticula.	Large, apart, with 2 diverticula each. Opaque.	Large, close together, with 2 diverticula each. Opaque	Not present.	**Not present.**
The *ventral* or *inner setæ* in each couple exclusive of those in the genital region, are:	Only a little closer together than the setæ of the outer couple.	Only a little closer together than those of the outer couple.	Several times closer together than those of the outer couple.	Several times closer together than the outer couple.	**Several times closer than the outer couple.**
Prostate, the glandular part	Helix-like at the top. Muscular part not very short.	Not helix-like; tubular, straight or bent.	Not helix-like; tubular and broad at the base. Top enlarged knob-like.		**Helix-like at the top. Muscular part very short.**
Gizzard	None.	None.	None.	None.	**Rudimentary.**
Diverticula of the spermatheca	Absent.	More than ½ as large as the spermatheeal pouch.	About ⅓ as large as the spermatheeal pouch.		
Penial setæ	Two on each side.	Two on each side.	Two on each side.	One on each side.	**Two on each side.**
Nephridia commence in	ii.	ii.	ii.	ii.	**v.**
Nephridio-pores in front of and little interior to	4th and 3d setæ. Prominent in the clitellum.	4th and 3d setæ.	4th and 3d setæ.	3d setæ.	**3d setæ. Not prominent in the clitellum.**
Spermducts	Remain separate up to the atria.	Remain separate up to the atria.	Remain separate up to the atria.	Remain separate up to the atria.	**Unite to form one tube on each side which opens in the muscular part of the atrium.**
Posteriorly to the clitellum the setæ have regained their normal distance in somite	xxvi and xxvii.	xxi.	xxi.		xxiii and xxiv.

ARGILOPHILUS.

Argilophilus Eisen, Zoe iv, 252, October, 1893.

Prostomium encroaches on somite i. Eight setæ in four couples, ventral, lateral and dorsal, commencing in somite ii. The setæ of the inner couple not converging towards the male pore, but closer set than the setæ of the outer couple. The alimentary canal consists of an eversible buccal cavity, a pharynx, œsophagus, gizzard, tubular intestine, sacculated intestine, typhlosole, but no œsophageal glands or pouches. Clitellum not developed ventrally, occupies somites xiii to xviii.

Spermathecal pores, one pair vii/viii and one pair viii/ix. Ovipores in xiv. Male pore in xviii. One or two rows of ventral intersegmental papillæ. Two pair of spermathecæ. Testes in x, xi. Sperm-sacs paired in x, xi, xii, generally enclosing the ciliated funnels and testes. Two pair of ciliated funnels. Two pair of sperm-ducts, which join a pair of very large, tubular-coiled prostates in xviii, at the upper end of the muscular duct. Two penial setæ open in the same pore, but not in the same duct as the prostate.

Dorsal vessel and ventral vessels connected by 5 pair of hearts in xiv to x. No. subneural vessel. Blood red. Many blood vessels on the nephridia. No pepto-nephridia. The nephridio-pores variable as to location, the majority open in front of or lateral to the 4th setæ, though many open interior to the 4th setæ. No cœcal bladder at the exterior pore. Large earthworms with thick round bodies, of pale flesh color, marbled bluish.

Distribution and habitat. The genus Argilophilus appears to be an undoubted native of the Pacific Coast. Specimens have been found in the San Joaquin Valley in California, and as far north as British Columbia (Vancouver Island). In California these worms are our most common earth worms, appearing close to the surface with the advent of the rains in the autumn and disappearing deep in the soil with the dry weather in May, after which time they are not any more found in even locally moist places. During the summer months I have sometimes dug up these worms from a depth of 5 to 6 feet or more, each worm tightly rolled up as a little ball and appearently encysted in a chamber of clay, the inner surface of which is smooth and hard. In these cysts the worms pass the dry season. These worms are hardly ever found outside of heavy adobe or clayey soil; the more clayey the soil, the better the worms appear to thrive, provided also the soil is rich and fertile. In poor soil the worms are seldom seen, and the best indorsement for a soil is that it contains worms of this genus.

The color of the worms of this genus is fleshy pink, thickly marbled, with steel or slate gray, (fig. 132). The clitellum is yellowish red, and the whole anterior part is pinkish. The color of these worms is very handsome and distinguishes them from the deep brown Allolobophora so common in moist or swampy places in this State.

Exterior characteristics (figs. 125–131). The most prominent exterior feature of this genus is the color which has just been described. Another is the frequent eversion of the lining of the buccal sac (fig. 130). As to size the worm must be considered as our largest earthworm, though very variable, as might be expected. The smallest adult worms measure about 1½ inches by 3 lines, the largest again 6 inches by 4 to 4½ lines, the size appears to depend greatly on the locality and richness of the soil. The prostomium divides somite i to about ½ or ⅗ (fig. 130). Somites vii, viii, ix, are larger than the other anterior somites. The clitellar somites (figs. 125 to 131) are large, the post-clitellar ones are very much smaller. The spermathecal pores are more or less conspicuous (fig. 129 *spth.*), sometimes hardly visible, at times again elevated and appearing as small round rings. They are situated just lateral to setæ 2, but of course in the intersegmental grooves between vii/viii and viii/ix. The ovipores are closer together, situated a little more ventrally than setæ 1, sometimes, if not generally, connected by a depression. The clitellum is only developed dorsally and laterally, the ventral part between the male pores being normal and appearing as considerably depressed, in hardened specimens the depression reaching as far forward as to the center of somite xiv or the ovipores.

The male pores which open in line with setæ 2, are situated on either side on an elongated papilla, which again is more or less surrounded by a circular depression, outside of which is seen a high semi-circular ridge, which is thicker anteriorly and posteriorly than laterally (fig. 25, 129). The penial setæ are one pair in each pore, and are seen protruding through the male-pore.

The regular setæ are sigmoid, not greatly bent. The setæ of the inner couples are closer than those of the outer couples; all the setæ are in parallel rows (fig. 24). The nephridio-pores are difficult to view from the outside. Their arrangement is variable, but the majority are found outside of, or more lateral than the fourth row of setæ. The three anterior nephridio-pores are seen in front of setæ 4 (fig. 24). A more detailed description will be given further on.

Setæ. The ordinary setæ have been already described as sigmoid. There are two sacs of penial setæ attendant to each prostate, and opening in the same pore, but not in the same duct, as that organ. There is only one seta in each sac. This seta is sickle-like, much more curved than those in Deltania. The point is needle-like, and curved (figs. 122, 123). The very point is void of sculpture, but the part back of the point and up to the sac is sculptured as in the figure 123. The largest part of the seta is smooth, only showing the rings for the attachment of the muscles. The inner couples of setæ of the clitellum are somewhat raised, though otherwise not differentiated.

ANATOMICAL STRUCTURE.

The *body-wall* (figs. 114, 115, 116, 117, 118). The body-wall outside of the clitellum shows the usual sets of layers. The innermost vascular layer, which covers the longitudinal muscular layer, is very thick and prominent, though not very crowded with blood vessels (fig. 114). Under this layer, and between it and the longitudinal muscles, passes the spermduct, almost throughout its length, from the place where the two ducts unite to the one where they rise to join the spermduct. This layer is less pronounced anterior to clitellum, and appears absent in the vicinity of the spermatheca and anterior to them. In the clitellar somites this vascular layer is especially prominent. The muscles of the longitudinal muscular layer in this genus, as well as in Deltania, are arranged in groups or projecting lobes, between which pass projections of the vascular layer, as well as transverse muscles in certain places. These lobes vary in width, and on the ventral side below the ganglion are arranged fan-like (fig. 103, *v. p.*), diverging from the median line. The longitudinal muscles are never arranged around a central axis, as is the case in so many lumbricides, though they show a faint trace of symmetrical arrangement. The zone of the transverse muscles is much thinner, five or six times narrower than the longitudinal zone (117).

The hypodermis is thick, with large, glandular cells of a flask-like or spindle-like shape. In the clitellar somites these glands become irregular, club-like, and project as far inside the layer of clitellar glands as the hypodermis is thick, or more (fig. 116).

The clitellum is developed only dorsally. The glandular layer is much thicker laterally and dorsally, tapering towards the ventral side, and ceasing entirely at a line drawn outside of the male papilla and parallel with the ventral ganglion. The glandular layer of the clitellum is very thin, and as compared with that of Deltania, about $\frac{1}{3}$ narrower. The cells of this layer are, however, very wide and long, there being generally eight or nine in the row. They are irregularly grouped in twos or threes, separated by narrow blood vessels, which, at rather regular intervals, are thicker. They are supplied with blood from sinuses situated between the transverse muscles, and which connect through these branches with a capillary network on the hypodermis (figs. 115 and 116).

Transverse muscles (figs. 118 and 119). There are numerous sets of transverse muscular bands in the clitellar somites, quite similar to those described by Benham in *Moniligaster indicus*. They are more numerous and prominent in the somite of the oviduct than elsewhere, and form there three distinct muscular bands the ventral ends of which terminate at the inner couple of setæ (fig. 119); the lateral ends again terminate on the lateral side of the body wall.

The posterior band is the smallest of the three and begins in the posterior and ventral part of the somite, in line with, but slightly posterior to the inner setæ, stretching from there diagonally across the somite, ending laterally at the seta 3 (fig. 119, *m* 1).

The next band is much larger and begins in the anterior part of the somite also in line with the inner setæ and stretches diagonally backwards ending posterior to but in line with seta 4 (fig. 119, *m* 2.) The third muscular band is of the same size and runs in the same general direction as the last, begins and ends in front of it, ending in front of the fourth seta (fig. 119, *m* 3.) A fourth muscular band of a somewhat similar character connects the posterior part of the oviduct with the body-wall terminating in front of the muscular band just described as *m* 1, on the figure (fig. 119, *m* 4.) Similar muscles as the oviducal one, are common in all earthworms, connecting the various organs with the body-wall and require here no particular mention.

In the other clitellar somites we find bands of transverse muscles which stretch diagonally (fig. 118) across the body wall from the ventral part, almost immediately below the ventral ganglion, to the vicinity of the outer setæ. The ends of these muscles penetrate between the lobes of the longitudinal muscular layer (fig. 118, *l. m.*) These muscles are not continuous through the somite but are grouped in bands.

Ventral papillæ (figs. 120, 125 to 131). Argilophilus is readily distinguished from other California Eudrilidæ so far known, by its ventral papillæ, occupying the ventral side of the intersegmental grooves from the spermatheca to the segments next posterior to the clitellum. In *Argilophilus marmoratus ornatus* we meet sometimes with as many as 7 or 8 pairs, while in *A. m. papillifer* we find as high a number in a single median row, under the ventral ganglion. In no instance did I find a papilla on the segment itself, all invariably occurred rising from the groove between the somites, being in other words intersegmental. From cross-sections it will be seen that the papilla consists of two distinct parts, one exterior and lateral, consisting of elongated hypodermic supporting cells, which more or less fully enclose the interior main body of the papilla. This central part consists of larger or smaller gland-like bodies, varying in size and number according to the size and age of the papilla, etc. In some papillæ these bodies fill the larger part of the papilla, in others they are confined to the bottom or very center of the organ. As to the nature of these organs I am, as yet, somewhat in doubt, though they certainly must be considered as sensory organs of some kind. Stained with osmic acid the bodies present in sections a darker center, which appears of ganglionic nature, around which are grooped larger sacs which again are composed of smaller, light-refractive granules, giving the idea of a reticulated protoplasm. Numerous nerve fibres connect with those bodies, and evidently penetrate to the gaglionic center. Long tube-like cells butt directly on these glandulous bodies, while others grooped in bundles penetrate between them connecting with nerve ganglia. The transition between the supporting cells and the drainpipe cells of the papilla is sudden and not gradual. In fact the line of demarcation between the two is quite prominent. The supporting cells in the young papilla, entirely enclose the papilla, while in the larger and full grown papilla, they are pushed towards the side leaving the whole center to the drainpipe cells and the glands.

When stained with safranine the nuclei of the glandular cells become prominent, less so when stained with hæmatoxylon. The nuclei vary greatly in size and number. In some of the glandular bodies there are from one to three nuclei, in others none. In sections there are always less nuclei than divisions (cells?) apparently lying on the top of the reticulated mass. The nuclei may be seen directly above the nerve center, but generally they are found outside of it. It seems as if these glandulous bodies are modified agglomerations of hypodermic glands.

The arrangement of the glandulous bodies and the tube-like cells is very regular, the former resembling small sugar-loaves standing in a row, with the fan-like arranged tubular cells between them (fig. 120). In some sections a bunch of nerve fibers is seen on either side touching the papilla, connecting on the other hand with the ventral ganglion. As to the nature of the papilla Dr. Michælsen suggests that a somewhat similar organ in *Acanthodrilus georgianus* is a taste or "Wollust" organ. It is, however, not unlikely that the minute light-refractive bodies are glandulous.

Many of the tubular cells contain a fine granulated secretion in varying quantities, which stain dark red with eosine. The fact that the whole papilla is concave in the center speaks also strongly for the glandulous nature of the organ. The figure of the "Augenapfela"-like organ of Acanthodrilus, given by Michælsen, may possibly have been taken from a young papilla in which the glandulous bodies had not yet developed. Organs of a somewhat similar nature have also been described by Horst from *Pontoscolex corethrurus* which, however, he does not figure in connection with nerve fibres. It is not improbable that all the sensory organs in the genital somites of the higher Oligochæta are of an analogous nature. Among such organs would be included the tubercula pubertatis, the puberty grooves, as well as some other epidermal structures in Heliodrilus, Hyperiodrilus and Eudrilus described more in detail by Beddard. However all the organs require re-examination by the aid of other methods, as one single method of staining will not suffice to reveal their true nature.

Septa (fig. 86). The anterior septa are greatly pouched, generally to such an extent that in cross-sections the various organs appear to lie several somites further back than they really do. Thus the gizzard and the posterior spermatheca may be seen in the same cross-section and this is also the case with the oviduct and the sperm-sacs. This pouching is principally restricted to the septa 5 to 13. These septa are also slightly thickened especially those bounding somites viii to xi.

Nephridia (figs. 59 to 77). The position of the nephridio-pores places Argilophilus very close to Plutellus. There are one pair of nephridia in each somite as usual. The first pair of nephridia are found in somite ii and others follow in all the posterior somites. The first five or six nephridia are somewhat larger than the others and open in front of the fourth setæ. All the following open irregularly in front either of the third or fourth setæ, or in the space between and anterior to them, or even outside of, or more lateral than seta four. Those which open laterally of seta four do not even open in the same row, as we find one nephridio-pore say as far out laterally from the fourth seta, as that seta is distant from the third, while others are half-way or one-third of the way between the fourth seta and the most lateral nephridio-pore. There is no regularity as regards this succession, though rarely two successive nephridia open in line behind each other. For instance, one nephridium opens in front of seta 3; the second as far outside of 4 as 4 is distant from 3; the third nephridio-pore is in front of seta 4, the following half-way between seta 4 and the most lateral pore, the following $\frac{2}{3}$ of the distance from seta 4 to the most lateral pore, the following in front of seta 4, the following again $\frac{2}{3}$ of the distance from seta 4 to the most lateral nephidio-pore, etc. (Fig. 124 *np. p.*)

The structure of the nephridium is considerably complicated. The nephridiostome, found in front of the ventral setæ, is unusually minute, and leads to a compartively short duct, which connects with the body of the nepridium proper, at the point where the single-tubed outlet leaves the folds. This tube is not convoluted (fig. 59 ①), but almost straight, very hard and solid, widening toward the base. When it reaches the folds it does not at once enter a tube, but forms a long, cylindrical, spongy mass (fig. 63), which extends the whole side or one-third of the length of the nephridium, before it assumes the proper shape of a clear canal (fig. 59, ② to ⑦, and fig 64). In the beginning at ②, this mass shows no regular lumen, but a number of irregular pores and tubes, which might best be compared to the inner canals of a common washing sponge (fig. 64, ③, ②, ⑮). In the center of this mass are imbedded the two parallel folds of the main nephridial canal (fig. 64, *a* and *b*). At first the spongy tube is located principally above the two canals, but soon the mass is shifted and the canals become imbedded in the center of the mass, or very nearly so (fig. 64, ③ to ⑤). The small connecting tubules at ②, which were at first so irregular, soon assume a greater degree of regularity at ③, while at the same time two longitudinal lumens are formed—one on the upper ⓤ and one on the under side (①, fig. 64) of the two central canals (*a* and *b*). At first these canals ⓤ and ① are indistinct and irregular, but soon they assume the character of regular longitudinal canals (from ④ to ⑤, ⑥ and ⑦). From ③ to ⑤ these canals ⓤ and ① are connected by the transverse tubules, which completely surround the two central canals ⓐ and ⓑ. At ⑤ the lower canal ① becomes narrower, and the transverse ducts drop into the main canal ⓑ, while the former lower canal ① assumes the character of a rather thick, epithelial lining. The general effect of this arrangement is, that, seen with a lower power, the spur between ③ and ⑤ appears to consist of four distinct parallel canals, while from ⑥ to ⑬ the fold contains only three parallel canals. At ⑨ these canals become very crowded, the whole fold being narrower. The length of this narrower part varies, but generally already at ⑩, or shortly before entering on the bent plexus at ⑬, the fold has regained its original width. At ⑬ the canals turn; that is, ⓐ connects with ⓑ and the central canal folds upon itself, and for a short distance we have four almost parallel canals. At ⑬ the formerly central canal (from ⑧ to ⑪, ⑫ and ⑬) leaves the lobe and crosses over to the other fold, and at ⑮ becomes the original canal ⓐ, which runs its course all through the two folds, at ⑦ turning downward, becoming the lower canal, which again at ⑫ becomes canal ⓑ, from there on pressing backward and again forward from ⑦ to ⑮, at which point it separates itself from the fold, and, running along the inner body-wall, forms the outlet duct opening at the exterior pore at ⑯. The connecting bridge between the two main folds, or rather between one fold and the free lobe of the other, between ⑭ and ⑮, is very narrow at ⑰, suddenly increasing at ⑭, gradually tapering toward ⑮. As regards the ciliation of the canal, it may be stated that it does not extend all through the tube. It appears that the canal is ciliated at places where the passage of the excretions is difficult. The narrow duct from the funnel to ⑮ is ciliated as well as the funnel itself. Again, the ciliation begins at the point of recurrence at ⑦, but ceases after the duct has assumed its straight course at ⑧; it begins again at ⑩, and is with a certainty found between ⑮ and ⑰, and possibly between ⑰ and ⑫, where, however, I am not quite certain of its presence. The whole nephridial fold is imbedded in a wing-like cellular and fibrous mass, which at either end becomes thicker, supporting large pellucid peritoneal cells, such as found in the nephridia of many Oligochæta (fig. 64, *per. c.*), and a complex system of blood-vessels, which branch and form capillary loops partly on the folds, but principally between the spongy tubes and the two central canals (figs. 59, 63, 64, 67, *bl.*). The blood-vessels originate from a branch of the ventral vessel as in Lumbricus.

Scattered over the peritoneal cells are masses of free cells, generally agglomerated in separate heaps. Each cell is deeply crenate, as if it consisted of several individual cells, but in each such small agglomeration there is only one round nucleus (fig. 80).

If we recapitulate, we find that the nephridum of Argilophilus consists of the following distinct part from the nephridio-stome to the nepridio-pore:

1. Nephridio-stome, engaged in the anterior septum.

2. Narrow duct, which connects the nephridio-stome with the body of the nephridium proper, especially with the spongy tubules.

3. Spongy tubules, which are at first irregular, but which soon fuse into one main-tube with many branching tubules.

4. Main nephridial canal, which, recurring on itself several times, forms two distinct folds and one spur. The posterior fold contains besides the tube and tubules two turns of the canal, one of which is recurring. The anterior fold contains three turns of the canal, two of which are recurring. Part of this anterior fold disengages itself from the main nephridial mass and forms the

5. Spur. This spur contains four canals, two of which are recurring, the point of recurrence for all four being at the distal end. One of the recurring canals of the spur is connected with the posterior fold by the

6. Bridge, a part of the canal much narrower than the other, spanning the distance between the two folds.

7. The wide duct leading to the nephridio-pore, directly connected with the recurring canal of the posterior fold. In different nephridia this wide duct is of varying length.

8. Nephridio-pore, apparently without urinary bladder or collar.

9. A large wing-like, but rather thin, mass of peritoneal cells.

10. A complicated and extensive system of capillary blood vessels on the various parts of the nephridium.

Compared to the nephridium of Lumbricus as described by Benham we find a few more important differences, especially in the post-septal part. Thus the post-septal part of the narrow tube after reaching the first loop assumes the shape of a tubular network, which only gradually fuses itself into one duct with numerous branching ductules, while in Lumbricus the single duct continues through the different lobes and in recurring winds around itself. The tubules in Argilophilus embrace the two tubes but cease after leaving the first fold. The muscular duct which is so prominent in Lumbricus is not represented in Argilophilus, but is replaced by an elongation of the single wide tube corresponding to the "wide tube of the 3d lobe" in Lumbricus.

Compared again with the nephridium of Deltania, we find that the principal difference consists in the absence of the urinary bladder and the collar at the nephridio-pore as well as in the absence of a cœcal bladder. The irregular or alternate locations of the nephridio-pores distinguish Argilophilus and Plutellus from all other earthworms, as far as known.

Alimentary canal (fig. 87 to 92). The *buccal cavity* is, as has been stated, greatly eversible, and generally remains everted after the worm is dead. The *pharynx* is only developed superiorly though there is a slight thickening of the lower wall of the buccal cavity at the junction with the œsophagus, at which place numerous muscles are seen to connect with the lower part of the body-wall. The pharynx is as usual furnished with numerous salivary glands (fig. 86, *sl. gl.*), extending from the vicinity of the brain to the posterior part of somite iv, the most posterior glandular mass being the largest (fig. 86). The various glandular lobes offer some characteristics, which if carefully noted and compared may be found to be constant enough to serve as species characteristics.

The *Œsophagus* begins in iii and occupies somites iii, iv and v, (fig. 86, *A. œ.*) forming first a narrow tube, which widens out, and rising upwards connects with a very large gizzard (*gz.*). This *gizzard* occupies in reality only somite vi, but its great length causes it to push far backward to such an extent that it actually occupies the space covered by viii and sometimes by ix. The gizzard is compressed from above, but widened laterally which makes it appear very much larger when viewed from above than when seen in vertical section. It connects posteriorly, in vii, with a very long narrow *tubular intestine*, which extends to somite xii, but which in somites xiii to xv is strongly nipped by the septa and considerably enlarged (fig. 86, *s*,) without, however, being strictly sacculated.

The *sacculated intestine* proper, however, begins first in xvi, and is much wider than the other part of the alimentary canal. The structure of the pharynx offers nothing of unusual interest. The wall of the gizzard contains the usual layers, but they are poor in blood vessels. The longitudinal muscular layer is thickest, and on the widest part of the gizzard it is five or six times as thick as the epithelium, gradually diminishing in size anteriorly and posteriorly (figs. 86, 87, 88, 89).

Pear-shaped or *Chylus Chambers*. Beginning immediately behind the gizzard, and extending throughout the tubular intestine, we find imbedded between the epithelial folds numerous pear-shaped organs of doubtful function. In pronouncing these as chylus chambers, I do so with much hesitation, as I am not at all satisfied but that instead of being organs of absorption, they may not in reality be organs of discharge, or in other words, glands. I found these chambers always empty, appearing entirely transparent in sections of the intestine, and they never stain, apparently showing a want of contents, though this may be a temporary condition, owing to the state of the worms when killed, at which time these organs may have happened to have been temporarily empty. As regards location, they are found principally in somites vii to xii, and seldom extend further back than that somite. It is to be remembered that in somite xiii the tubular intestine changes its form and becomes considerably sacculated. In somites vii to xii this tubular part is very poor in blood vessels, or rather in large blood sinuses, while in xiii these sinuses begin to appear in large number and of large size. Thus, with no blood sinus in the epithelial folds, there are many pear-shaped chambers, while on the contrary, the cessation of pear-shaped chambers is accompanied by numerous and large blood sinuses (fig. 93). The pear-shaped chambers are imbedded between the epithelial cells, and probably all of them reach the inner cavity of the alimentary canal, though, from the sections made, this is not quite evident. Some of them, however, do, as will be seen from the figures 90 and 91. They are unequally distributed; in some places they fairly crowd out the epithelial cells, as in fig. 91, which is drawn from a longitudinal section, showing an unusually large number. Fig. 92 represents a surface view where they are less numerous, and fig. 90 represents a camera drawing from a transverse section of the gut. Each chamber consists of six, seven, or, in some instances, of only two or three cells, arranged as the clefts in an orange, around a central pore or short tube, which, however, does not extend all through the papilla, but ends blindly. At the lower end these individual chambers connect with numerous smaller and more irregular cells, which join each other close to the transverse muscular layer. The small central pore stands frequently in connection with the alimentary cavity. In the smaller and inner chambers this pore is less pronounced or entirely wanting. At the base of the chambers are seen a number of small glandular masses, with grainy and opaque contents (fig. 90 *gl.*). As regards the distribution of the chambers among the epithelial folds of the same somite, it may be noted that they are principally numerous in the dorsal and ventral regions, disappearing in the lateral regions (fig. 133, *ep.* and *c. r.*). This is the case in all the somites where these chambers appear in the tubular intestine. Chylus canals have been described by Michaelsen as present in the intestine of Enchytræus, but the difference between their structure and those of Argilophilus is quite great. In Enchytræus these canals are principally intercellular, and connect with bloodvessels or sinuses, while the pear-shaped organs in Argilophilus are extra cellular, and occur in parts of the intestine especially poor in blood vessels. The impossibility to procure fresh worms will necessitate a closer study of these organs, to be deferred to a more opportune time.

Typhlosole. The typhlosole and typhlosolar region is small, and not especially pronounced in front of and in the clitellar somites. Anterior to somite xix the typhlosolar vessel, which is entirely dorsal, is many times smaller than the longitudinal dorsal vessel, but posterior to that somite the typhlosolar vessel assumes a larger size, almost equalling the main dorsal vessel. In the anterior somites the typhlosolar region does not project down in the intestine, but is only somewhat wider than the balance of the intestinal wall. The typhlosole in this part appears to be filled with a fibrous and spongy mass, in which, however, I have seen no distinct nuclei (fig. 134, *c. v.*). These cavities are more oblong at the walls, more round or angular at the center, where several larger cavities are seen. At the upper margin of the typhlosole this fibrous body gives room to two large and several smaller longitudinal canals, one at each extremity of the typhlosole, all separated by muscular fibers or cell-like chambers. In fig. 136 the fibrous nature of the interior of the typhlosole is somewhat more pronounced than it should be, the fibers appearing rather more regular than in reality, though the appearance is always as if the majority of the fibers radiated in a fan-like way from the central spongy mass. This part of the posterior typhlosole is in cross-section deltoid, with the point projecting into the cavity of the intestine (136, *ty*). The size of the typhlosole varies with the individual specimen.

Spermatheca (figs. 81 to 86). There are two pair of spermathecæ in viii and ix opening in the intersegmental grooves between vii and viii and viii and ix. The spermthecal pores are found in front of and slightly outside of the second setæ. As regards the size the spermathecæ may be said to be very large, but unequal, as we seldom find two of the same size. One or two are generally developed at the expense of the others and fill all the available space in the somites, frequently pushing the septa into the nearest somites. Seen in a transverse section of a segment the larger spermatheca may be occupying as much as three-fourths of the cavity (fig. 86). The spermatheca consists of two distinct parts, of which the upper is by far the largest, rounded in outline or potato-like with comparatively thin walls (fig. 82 *a*). This part, though somewhat warty, carries no diverticula and there are no smaller cavities for the storing of the spermatozoa. The lower muscular part is twisted, and set obliquely to the former, but can in no way be said to form any kind of a diverticulum (figs. 81 and 82). The muscular layer, which is a direct continuation of the longitudinal layer of the body-wall, is only arranged in one way forming a circular muscular stratum of the spermatheca much thicker at the base than at the top (fig. 82 *l. m*). This muscular layer extends to the upper part of the spermatheca (82 *a*), but is here quite narrow. The inner glandular layer is singularly well developed (figs. 82, *gl. e.*; 84 *gl. ep.* and 83), projecting inwards in large folds like the epithelial folicles of the intestine.

Secretions accumulate as a large whitish mass in the upper part of the spermatheca, and are seen to be sparingly mixed or streaked with spermatozoa. But the most characteristic part of the spermatheca is the interlacunary system for the storage of the spermatozoa in the lower or muscular part. A section of this part shows (figs. 82, 83 and 84, *l. s.*) a row of chambers imbedded between the epithelial cells, or between them and the muscular layer, and which connect more or less directly with the cavity of the spermatheca by means of narrow passages (fig. 83 *p.*) Some of the chambers stand also in connection with each other as at 84 *sp. b.* and 83. In these chambers are stored the spermballs proper, one in each, rarely occupying the whole space of the chamber, but leaving considerable of the lacunary room empty, it never containing any free spermatozoa, only agglomerations or spermballs. These spermballs may also be seen as white opaque globules from the outside of the spermatheca as represented in figs. 81 *A* and *B*, *sp. b.*

Testes (figs. 94, 95, 96.) There are two pair of testes, one in somite x, one in xi, as usual post-septal. The anterior testes are enclosed in the sperm-sac, the posterior ones are generally free. Cross-sections show the testes to be deeply multilobed, with the lobes spreading. As regard the enclosing of the anterior testes it may be remarked that it is more or less complete, evidently depending on the size of the sperm-sac. In some specimens the testes were entirely enclosed, in others only the posterior apex was invested in the sperm-sac. In most specimens the testes were found pressed close to the body-wall and projecting backwards, the point of adherence to the anterior septum being immediately above and adjoining the ciliated funnel of the nephridium in line with the ventral setæ.

Sperm-sacs. There are three sperm-sacs, more or less but generally paired in somites x, xi and xii, the one in the latter somite being much more lobed than the anterior ones, and more frequently paired. The two anterior sperm-sacs are much the largest (fig. 96 and 97). They fill the whole somites, are not always paired, but the lobes connect all along the dorsal body-wall. The anterior sac closely invests the testes and ciliated rosettes in x and furthermore often encloses the ventral ganglion (fig. 96 and 97). The sperm-sac in xi is also often closed on the dorsal side, but it does not invest the testes nor the sperm funnels of that somite (fig. 98). The sperm-sac in xii differs from the other by being deeply lobed in the plane of the trabeculæ which are arranged in a fan-like shape from the alimentary canal. This sperm-sac which is seldom paired, does not extend below the alimentary canal as the anterior ones do, but so to say rests entirely on the intestine (figs. 86 and 99). The anterior sperm-sacs are also traversed by numerous trabeculæ, which however are irregularly arranged (fig. 100). The sperm-sacs are frequently infested with parasitic coccidiæ of round shape and with from one to three germ cells (fig. 100, *coc.*) In size the sperm-sacs are so large that they push far backwards, the one pair covering the other, the whole mass often reaching as far back as to touch the prostate, thus entirely covering the ovary and oviducts. This is especially evident in transverse sections when the ovary, oviduct and the three sperm-sacs may be seen at once.

The *ovary* is, as usual, found in xiii and offers no great peculiarities. It is generally deeply lobed, and in cross-section shows the same projecting lobes as the testes.

The *oviduct* is rather thin and characterized by a thick and long upper lip (fig. 103 *u. l.*), which generally is bent to one side. In one instance the upper lip was forked (as in fig. 103, *c.*). The muscle attaching the upper part of the oviduct to the body-wall is unusually strong (fig. 103, *m. s.*).

Spermducts and *prostates* (figs. 103 to 113). There are two pair of sperm funnels and ducts, the ducts joined together. The ciliated rosettes or sperm funnels are found in x and xi. The anterior pair is engaged in the sperm-sac of that somite (fig. 97), while the posterior pair is generally free (fig. 98). I have, however, seen the sperm-sacs attached to the funnels in these somites in some specimens, and there appears in this respect to be considerable variation; generally, however, the rosettes are free (fig. 98) in somite xi. Also with the anterior funnel there is some variation. In some specimens the funnels were entirely enclosed in the sperm-sacs, in others the sperm-sac was merely attached to the free surface of the funnel, while in others again one-half of the funnel was imbedded in the sperm-sac, while the other half was free. Figs. 97 and 98 show cross-sections with the sperm funnels or ciliated rosettes free or imbedded.

The *spermducts* join in xii and continue in a direct line to the prostate, which they enter in somite xviii. The point of junction is in the lower part of the glandular part close to the muscular duct (fig. 86, *e.*). The duct runs between the very thick vascular layer and the longitudinal muscular layer of the body (figs. 117 and 118, *sp.*). The two ducts are never fused together, but continue distinct and separate, though outwardly joined, as to the very entrance in the muscular part of the prostate (figs. 112 and 113). While the junction of the spermduct and the prostate is, to all appearances, in the glandular part of the prostate (figs. 110 and 113), the real point of entrance is in the muscular duct (fig. 113, *spd.*). After having touched the glandular part, the spermducts bend and cross the intervening space to the muscular prostate which they enter in a slanting direction, then passing considerably downward enclosed in the muscular part of the prostate, before entering the lumen proper (figs. 106, 107, 110, 111, 112, 113). Fig. 113 represents a cross-section in which the spermducts have been cut twice. Part of the spermduct is seen free close to the glandular part of the prostate, part again is seen just at the fusion of the ducts with the lumen of the muscular part. The duct closest to the lumen has been partly differentiated, the cells having lost their nuclei.

The *prostate* consists of a very large cylindrical, but greatly coiled, duct (figs. 106 and 107 and 1), which generally lies pressed flat to the body wall of xviii (fig. 86, *pr.*) It opens outwardly in xviii in the posterior part of the somite in the same pore as the penial setæ.

There are two layers of cells in the glandular part, but apparently no muscular layer between them. The outermost layer consists of large glandular lobes containing glandular cells which pass between the inner cell layer, and discharge in the lumen of the prostate (see figs. 108 and 109). There is a large system of blood vessels which penetrate both of the cellular layers, but which is not developed to the same extent as in Deltania.

In cross-section of the body-wall (fig. 103 *A*) the prostate is seen to open laterally to the penial setæ, though in the same pore, situated at the very junction of the glandular clitellum and the ventral zone (*v. p.*) of the body (fig. 103 *A.* ♂).

Vascular system (fig. 86 *B* and 119). The following remarks on the vascular system can only be considered as preliminary, a more detailed report being reserved for a future study of living specimens. The main system consists of two longitudinal vessels, one dorsal and one ventral. There is no subneural vessel. Three pair of stout, oblong, thrice-contracted and sac-like hearts connect the ventral and dorsal vessels in x, xi and xii. The typhlosole has already been described.

The secondary vessels are characterized by numerous bead-like constrictions and swellings of the smaller branches, especially of those surrounding the funnels of the nephridia, and of the secondary vessels of the ventral longitudinal vessel.

Of the genus Argilophilus there are two rather distinct forms in California, which however, only differ externally, and, strange enough, have not, as a rule, been found in the same locality. Through careful dissection and sectioning I have not been able to distinguish any anatomical differences between the two species, though I have never seen any transitory forms as regards to the external markings. According to our present knowledge of earthworms we always expect to find internal specific characteristics of the species, and if such are not found we must hesitate to consider the respective forms as different species. Under such circumstances I will here refer to the two forms of Argilophilus only as varieties or subspecies, leaving to further investigations, if possible, to detect any internal differences.

Argilophilus marmoratus ornatus.

Figs. 125 to 129.

Argilophilus marmoratus ornatus Eisen, Zoe, iv, 253, October, 1893.

There are two rows of ventral papillæ between some of the somites in the vicinity of the clitellum, interior or posterior to it, or both. These papillæ are always more or less in line with setæ i, of rounded or slightly oblong form, and generally more or less of the same size. The number of papillæ varies, and frequently one papilla in a pair is wanting.

Habitat. I have found this worm only in the vicinity of Santa Rosa, Sebastopol, etc., north of San Francisco Bay. It occurs there in rich heavy soils, and constitutes the most common earthworm of the district. In the vicinity of Sebastopol I found this subspecies both in manure piles and in the wet, soggy places near the lagoon, places which part of the year must be covered with water from the slough or lake. Among several hundred worms collected in the month of May during one day, I found only one single specimen with median papillæ; all the others possessed lateral papillæ (fig. 125 to 128).

The *body* is thick, cylindrical, and only slightly tapering toward either end (fig. 132). As usual, the anterior segments are much wider than the post-clitellar ones. The prostomium frequently protrudes like an inverted sac hanging over the peristomium (fig. 130), as is probably the case with most genera of this family. While the anterior somites are well set off, the clitellar somites are less distinct, though they can always be made out. The clitellum comprises somites xiii to xviii, though the posterior ¼ of xii is generally also somewhat thickened. Of the anti-clitellar somites vii, viii, ix are thicker than the others, and as thick as the somites of the clitellum. All the somites are deeply segmented, except the clitellar somites and those anterior to iii. The external pores are situated as follows: Spermathecal pores, two pairs, between vii/viii and viii/ix, a little lateral of the seta 2. Oviducal pores in xiv in front of seta 1, generally in a slight depression, bordered by a swelling of the body-wall. The male pore and pore for penial setæ combined in one, open in line with seta 2 in xviii. The male pore is characterized by being situated on an elevated papilla more or less oblong. This papilla is surrounded by a circular depression which encroaches on the two adjoining somites (xvii and xix), and this depression is again surrounded by a lunar ridge, open ventrally, and extending from the center of xvii to the center of xix, thus reaching slightly outside of the clitellum (fig. 129). The clitellar glands do not extend further ventrally than to a line running from the center of the lunar ridge parallel to the setæ. The ventral part of the clitellum is depressed.

Ventral papillæ. One of the most interesting features of this genus are the intersegmental glands occurring on the ventral side and which in our present species are paired. They have possibly the same general function as the tubercula pupertatis of the true Lumbricids, or the ventral papillæ of Perichæta, etc., which latter they greatly resemble, but unlike the former they are variable in position, sometimes occurring to the number of as many as seven pairs. In other specimens again they are reduced to one solitary tubercle, situated on one side of the ventral median longitudinal line. The most common form is as follows:

One pair between viii/ix.
One pair between ix/x.
One pair between xv/xvi.
One pair between xvi/xvii.
One pair between xix/xx.

Other specimens possessed in addition to these pairs:
One between xx/xxi.
One between xxi/xxii.

To show the variability of these papillæ I give their places in a few individuals picked out at random, and I only add that other variations occur, as may be expected, from what is shown here. All these specimens were taken the same day and at the same locality:

No. 1. One pair, viii/ix.
One pair, ix/x.
One pair, xv/xvi.
One pair, xvi/xvii.
One pair, xix/xx.

No. 2. One pair, ix/x.
One single, xv/xvi, left side.
No. 3. One pair, ix/x.
One pair, x/xi.
One single, xiv/xv, right side.
One pair, xv/xvi.
One pair, xvi/xvii.
One pair, xx/xxi.
One pair, xxi/xxii.
No. 4. One pair, x/xi.
One pair, xv/xvi.
One pair, xix/xx.
No. 5. One pair, x/xi.
One pair, xix/xx.

The structure of these papillæ has been referred to in connection with the body-wall, and apparently does not differ in the two forms.

Argilophilus marmoratus papillifer.

Fig. 131, A and B.

Argilophilus marmoratus papillifer Eisen, Zoe, iv, 253, October, 1893.

The ventral side of the somites with one single median row of ventral papillæ, which are generally largest between the clitellar somites, diminishing gradually in size toward the anterior somites. The papillæ of this form are generally, but not always, more oblong than in the preceding form, where they are much more rounded. The clitellar papillæ are frequently diamond-shaped (fig. 131). The papillæ vary greatly in number and size in various individuals, but they are always median, never paired. Sometimes there are 6 to 7 papillæ posterior of the clitellum.

Habitat. This worm is very common in the vicinity of San Francisco Bay, south of Santa Rosa, where the former form begins. I have also this form from Santa Clara County, Monterey County, Fresno County, etc. It is common in the foothills of the Sierra Nevada, in Nevada County. Among many hundred specimens collected there was only one which possessed the paired papillæ of the former form.

Systematic position. The peculiar variation of the nephridio-pores places Argilophilus in undoubted proximity to Plutellus, both as described by Perrier and Benham. The extra chætal pores in Argilophilus warrants however the formation of a new genus, even if no other important characteristics would help to make it yet more distinct. As is well-known, Perrier's description of the ovaries, etc., in Plutellus have always been considered doubtful, and by Benham have been shown to be incorrect. This of course only in the case that Benham's worm really belongs to the same genus as the one described by Perrier. I do not doubt that this is so, because the positions assigned to the ovaries by Perrier is so abnormal that it is more than likely that a mistake was made, as Benham has already pointed out. But on the other hand Benham's worm came from Queen Charlotte's Islands in the Pacific, while Perrier's worm came from the Atlantic Coast, many thousand miles away, and it will always be impossible to with certainty decide upon the position of the ovaries in Perrier's Plutellus until the original worm has again been investigated. That it will be found to entirely agree with the normal type I do not doubt.

From Plutellus our Argilophilus differs in several important points besides the location of the nephridio-pores. First, in regard to the number of the ciliated rosettes—in Plutellus only one pair, in Argilophilus two pair. One pair of sperm-sacs in Plutellus, three pair in Argilophilus. One pair of testes in Plutellus, two pair in Argilophilus. Four pair of small spermatheca in Plutellus, two very large ones in Argilophilus. Perfect clitellum in Plutellus in at least two somites, ventrally imperfect clitellum in Argilophilus. In other respects the two genera resemble each other greatly, and through the respective arrangement of the nephridio-pores, they form a distinct tribe or sub-family for which I propose the name *Plutellini*.

The following table will show the principal characteristics of the two genera:

	Argilophilus.	*Plutellus.*
Prostomium dovetailing the peristonium	Partly.	Completely.
Clitellum	Ventrally imperfect.	Ventrally perfect in at least two somites.
Nephridio-pores	In front of setæ 3, 4, and outside of 4; generally the latter, the arrangement being irregular.	In front of 3 and 4, alternating rather regularly.
Gizzard in	v.	vi.
Spermatheca	Two very large pair in vii and viii.	Four or five pair in vi, vii, viii and ix.
Sperm-funnel	Two pair in x and xi.	One pair in x.
Testes	Two pair in x and xi.	One pair in x.
Sperm-sacs	Three pair in x, xi, xii.	One pair in xi.
Ovary and *oviduct* in	xiii.	xiii.
Ovipore in	xiv.	xiv.
Male pore in	xviii.	xviii.
Prostate	Very large, coiled, extending through several somites.	Straight, tubular, not very large, confined to one somite.
Nephridia commence in	ii.	iii.
Nephridial bladder at the entrance to the body-wall	Absent, the duct being single and straight.	Large, but of varying size in the two series of nephridia.
Ventral papillæ on the body-wall.	Present in pairs or in a single one.	Absent.
Copulatory setæ.	Present.	Absent.
Typhlosole	A small typhlosole present.	No typhlosole.

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EXPLANATION OF THE FIGURES.

DELTANIA ELEGANS, Figs. 1–20.

1. A medium sized worm, natural size.
2. The anterior part magnified, seen from the ventral side, to show arrangement of setæ and the exterior pores of various organs. *p. n. p.* the first three pepto-nephridio-pores in somites ii, iii and iv. *n. p.* nephridio-pores of the following somites, opening in front of the 3d setæ, the pepto n. p. opening in front of the 4th setæ. *o. p.* ovipore. *s. pd. p.* spermiducal pore.

In order to show the outer setæ, the body has been slightly flattened out. In reality the outer setæ should be slightly more dorsal than what appears.

3. The prostomium with somites i and ii.
4. Schematic view of the arrangement of the setæ on both sides of the male pore. The italic numerals indicating the order of the setæ, the roman numerals indicating the number of the somites.
5. The interior of the ventral surface of the genital somites viewed from above, showing the arrangement of the generative organs, etc. *spth.* spermathecæ. *c. r.* ciliated rosettes. *sp. s.* sperm-sacs. *sp. d.* spermducts. *ov.* ovary. *od.* oviduct. *p. s.* penial setæ and sacs. *pr.* prostate. *v. gl.* ventral ganglion. *t.* testes.
6. Longitudinal section of the anterior part of the body. The posterior section is a little more eccentric than the anterior. *br.* brain. *sl. gl.* salivary glands. *s. gl.* septal glands. *phx.* pharynx. *s. plx.* sigmoid plexus of the œsophagus. *sp. s.* sperm-sacs. *h.* hearts. *dv.* dorsal vessel. *t. i.* tubular intestine. *s. i.* sacculated intestine. *pr.* prostate. *s. ps.* sacs with penial setæ. *v. gl.* ventral ganglion. *œs.* œsophagus. *spth.* spermatheca. *t.* testes. *c. r.* ciliated rosettes. *ov.* ovary. *od.* oviduct.
8. Prostate and male apparatus. *pr.* prostate. *sp. d.* spermduct. *p. s.* penial setæ and sacs. *ms.* longitudinal muscular layer of the body wall.
9. Oviduct in xiv and xiii.

10. One of the septal glands in somites vi, vii, viii and ix.
11. Ciliated rosettes.
12. Ovary.
13. Spermatheca.
14. Exterior male-pore and penial papillæ. ♂ male-pore. *p. s.* penial setæ and papilla.
15. Exterior view of the clitellum seen from the ventral side. *op.* ovipore. ♂ male and prostate pore.
16. One of the regular setæ.
17. Penial setæ from somite xvii.
18. Testis from somite x.
19. Nephridium from somite xv.
20A. Anterior nephridium from somite ii.
20B. A nephridio-stome from one of the posterior nephridia.

DELTANIA TROYERI, Figs. 21–38.

21. Diagramatic view of the regular arrangement of the setæ in several somites posterior to the clitellum.
22A. A medium size worm.
22B. The largest specimen.
23. The anterior part seen from above, showing prostomium and somites i, ii, iii.
24. Schematic view of the arrangement of the inner setæ in the region on both sides of the male-pore. *ovp.* ovipore. *p. s.* penial setæ. ♂ male-pore.
25. The outside of the male genital region. *f.* folds in the body-wall. *p. s.* penial setæ. *p. p.* penial setæ papilla. *pr.* and ♂ prostate and male-pore. *c. d.* cupshaped concave region or sucker near the male-pore. *c. c.* central cavity between the male-pores. *m. st.* place for missing setæ No. 1. *s. st.* seta No. 2. *p. m.* penial muscles, arranged fanshaped, connecting the male-pore with the intersegmental groove.
26. Longitudinal section of the anterior part of the body. *b. c.* buccal cavity. *phnx.* pharynx. *sl. gl.* salivary or pharyngeal glands. *br.* brain. *s. gl.* septal glands. *s. ple.* sigmoid plexus of the œsophagus. *sp. s.* sperm-sacs. *æs.* œsophagus. *t.* testes. *spth.* spermatheca.
27. Somewhat schematic view of the alimentary canal seen from above. *œs.* œsophagus and pharynx. *sl. gl.* salivary gland. *s. gl.* septal gland. *d. v.* dorsal vessel. *h.* hearts. *t. i.* tubular intestine. *s. i.* sacculated intestine.
28. Brain and ventral ganglion.
29. One pair of the septal glands (vi).
30. Spermatheca from ix. Side view.
31. Spermatheca seen from below.
32. Spermatheca seen from above.
33. Male apparatus. *pr.* prostate. *p. s.* penial sacs and setæ. *sp. d.* spermduct. *ms.* muscles of the body-wall.
34. Nephridium from somite xv.
35. Oviduct and ovisac, left side.
36. The same from the same individual, but from the right hand side of the ventral ganglion.
37. The same sac seen from above.
38. Detail of the same.
39. Arrangement of the setæ surrounding the spermathecal pores.

DELTANIA BENHAMI, Figs. 40–48.

40. Arrangement of the setæ surrounding the spermathecal and male-pores. The same proportion and scale as in the preceding figure.
41. Sperm-sac.
42. Spermatheca, left side.
43. Spermatheca, right side of the same individual.
44. Oviduct.
45. Prostate gland and penial setæ. *v. v.* blood vessel covering the prostate.
46. Alimentary canal. *phx.* pharynx. *sl. gl.* salivary glands. *s. gl.* septal gland. *œs.* œsophagus. *s. i.* sacculated intestine. *c. i.* contracted part of the intestine generally commencing somewhere between somites xxvii to xxxvi and continuing towards the tail. In the first six somites the contraction is generally much narrower than in the following.
47. The worm natural size.
48. The male papillæ on somite xvii, showing the projecting penial setæ. The upper shaded part is the clitellum proper which ends at the center of the somite in line with the male-pore.

DELTANIA ELEGANS, Figs. 49–56.

49. The lumen and cœcal part of the nephridium in transverse section to the body. *fl. c. c.* flask-like glandular cells of clitellum. *bl. v.* blood-vessels in the transverse muscular layer. *t. m.* transverse or circular muscular layer. *l. m.* longitudinal muscular layer. *l. n.* lumen of cœcal part of the nephridium. *i. l.* interior lining of the nephridium. *gl.* glandular outer layer of nephridium. *cal.* calculi projected by the nephridium. *gl.c.* glandular cells of the clitellum. *atr.* urinary bladder or large contractile (?) chamber near the exterior pore of the nephridium. *ms.* muscular layer of the nephidial duct joining the flask-like cells of the clitellum. *col.* collar of the nephridium forming the exterior pore and consisting of regular layers of large, almost rectangular cells.

50A. Section through the body-wall and the lower part of a nephridium in somite xviii, but posterior to the clitellum. *n. d.* nephridio-duct. *c. n.* cœcal nephridio-bladder. *l. m.* longitudinal muscles. *c. m.* circular muscles. *ep.* epidermis and cuticle.

50B. Section through the body-wall and the nephridial collar in a somite posterior to the clitellum, illustrating the large ganglion (?), below the nephridial collar. The section shows the beginning of the nephridial collar and the place where it joins the cœcal vesicle.

50C. Section closely following the former nearer the nephridio-pore, showing a larger part of the ganglion. *i. c.* interior chamber or tubule, probably opening into the nephridial cœcum. *e. b.* inner lining of the cœcal bladder. *m. b.* muscular layer of the bladder. *c. np.* collar of nephridium. *n. gl.* nerve ganglion. *l. m.* longitudinal muscular layer of the body-wall. *t. m.* transverse layer of the body-wall. *h.* hypodermis.

51. Lower part of the prostate and penial sac, section through the male-pore, showing the junction of one of the penial sacs with the prostate. *p. s. s.* penis sac with setæ. *p. s.* one of the penial setæ broken. *pr.* and *ps.* prostate and male-pore. *pr. d.* prostate duct.

52. Section through the male-pore, cross-section through the body-wall, showing junction of the two spermducts, and prostate, and one of the penis sacs. *sp. d.* spermducts. *j. sp.* junction of spermducts. *pr.* prostate. *j. sp.* and *pr.* junction spermduct and prostate. *s. ps.* sac of penial setæ. *j. pr.* and *p. s.* junction of prostate and penal setæ. ♂ male-pore. *ep.* epidermis. *c. m.* layer of circular muscles, body-wall. *l. m.* layer of longitudinal muscles, body-wall. *n. c.* nerve cord from ventral ganglion. *p. p.* penial papilla.

53. Section through the male-pore showing junction of the two penis sacs with the prostate. *ps.* the two branches of the penis sac with the penis sheaths and penial setæ. *pr.* prostate. *c. m.* circular muscles. *l. m.* longitudinal muscles. ♂ male-pore. *atr.* atrium, or junction between the penis sacs and the prostate.

54. Section through the muscular part of the prostate. *gl.* inner glandular layer. *m.* outer muscular layer. *blv.* blood-vessels and cuticle.

55. Section through upper end of prostate. *blv.* bloodvessels. *c. v.* vessels between the inner and outer layer of cells. *i. v.* inner capillary vessels, lining the inner surface of the prostate.

56. Section through prostate at the junction of the muscular and glandular part. *m. pr.* muscular prostate; other letters same as in Fig. 54.

57A. Section through intestine in somite xv. *ch. l.* chloragogic layer. *l. m. l.* longitudinal muscular layer. *v. l.* vascular layer. *blv.* blood-vessel of the epithelium. *ep.* epithelial layer.

57B. Section through intestine, somite xiv.

57C. Section through intestine, somite xvi.

58. Cross-section through the clitellum, showing the relative size of the various layers.

ARGILOPHILUS MARMORATUS ORNATUS, Figs. 59–130.

59. A nephridium from one of the somites posterior to the clitellum. [*] **o,** inner orifice or nephridio-stome engaged in the muscular dissepiment *d.* **1,** narrow duct connecting the funnel with the fold. *p. f.* posterior fold. *a. f.* anterior fold. *u.* upper part of the spongy duct, which at **15** stands in direct connection with the narrow tube **1.** *l.* lower part of the spongy duct gradually increasing in size towards **5.** *a.* upper main canal. *b.* lower main canal, both the upper and the lower being different ends of the same canal. *o. c. f.* point of recurrence. *p. c.* peritoneal cell covering or support of the nephridium. *n. p.* nephridio-pore. *c. t.* capillary tubules of the spongy duct. *bl.* blood-vessels. *cap.* capillary blood-vessels surrounding the canals *a* and *b.* **1** to **17** mark places from which the detail drawings are taken. The nephridium is longer in proportion to its thickness than what is shown in the figure. If the part between the two parallel lines at **18** was increased to about one-third or one-fourth the entire length of the nephridium the proportion would be correct. If the whole nephridium had been drawn the figure would have been too long for the plate.

60. Nephridio-stome, front view.

61. Nephridio-stome, side view.

62. Nephridio-stome, end view.

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[*] Letters and figures in full-face type refer to those in rings on the plates.

63. Inner part of nephridium more highly magnified. The numerals indicate the same places as in Fig. 59. The letters are the same as in the above figure.

64. Part of the same more highly magnified in order to show the capillaries and their connection with the inner duct of the tube. *t. f.* tube leading to nephridio-stome. *a.* upper canal. *b.* lower canal. *i. l.* inner lumen of the duct which connects at *c.* with the capillaries. *c. t.* capillary tubes, longitudinal view. *c. t. c.* capillary tubes seen in cross-section. *sp. c.* spongy canal or tube directly connecting with the duct **1** and containing the capillaries. *o. c.* outer canal leading to the nephridio-pore. *c. br.* the narrow bridge connecting the two main folds. *p. c.* point where ciliation begins. *bl. v.* blood-vessels, connecting with capillary blood-vessels surrounding the two inner canals *a* and *b*; only a part of the blood-vessels are drawn. This figure was carefully drawn with camera lucida, though, on account of the minuteness and numbers of the ductules *c. tc.* and *c. t.*, it was impossible to delineate all, almost one-fifth having been left out in places where they crowded each other.

65. View of the spongy duct between **3** and **4** showing the inner canals *a* and *b* and the connecting ductules; letters indicate the same as in previous figures.

66. The same spongy duct near **4**, end view, and partly cross section.

67. The posterior fold as seen at **5**, the crosses + and × indicate the respective point corresponding on fig. 59, in order to show the direction of the tube, which is contrary to the one shown on fig. 59. *sp. t.* the spongy tube with the upper and lower ducts, connected by ductules *c. t.* *bl.* bloodvessels. *cap.* capillary bloodvessels, some of which surround the inner canals, others the outer fold. At the place marked with a × the ductules begin to connect the upper spongy tube with the lower main canal instead of with the lower part of the spongy tube, as at *c. t.*

68. A somewhat larger figure of the last taken at the end ×, where the lower part of the spongy tube has almost vanished and become bereft of its tubules *c. t.*, capillary tubes entering canal *b.* *c.* chambers on the central canal in the spongy tube, which send off tubules on the other side of the two main canals, and which also enter the canal. *b. l.* lumen of the spongy tube. In this and the previous figure will be seen how the tubules of the spongy tube shown in figs. 65 and 66 have been found forming a more regular lumen *l*, which in the next figure will be seen to emerge into or change to a regular canal.

69. Part of the upper fold at **7**, showing the tubules of the spongy tube to cease, the tube itself to become more regular, fusing itself in canal *b.* The arrows show the direction of the fluid or excretions from the nepridio-stome to the pore.

70. Diagramatic section of the main fold at the place where the capillaries of the spongy mass have ceased, and at the very point of the outer band marked fig. 59 *o. c. f.* The spongy mass surrounding the canals is now void of tubules.

71. View of the anterior fold at **10**, showing the inner ciliated canal—formerly the lumen of the spongy tube—and the two canals *a* and *b*, which are enclosed by a common glandular mass, a continuation of the spongy tube. The lower fan-shaped lines are possibly openings or valves in the tube, connecting with the glandular mass. As will be seen, the glandular mass is not continuous, but seemingly separated by lumens—*l*—which may prove to be canals connecting with the tube at the slits above referred to.

72. A part of same fold between **9** and **10.** The lumen is here void of cilia, and the glandulous mass is smaller

73. The main fold as seen at the narrow place **9.** *l.* lumen void of cilia. *a.* one of the canals *a* or *b* seen on the other side of the lumen. *bl. v.* bloodvessels surrounding the lumen and its glandular walls.

74A. Cross section of the posterior main fold taken at **3,** before the main central lumen in the spongy duct was formed.

74B. Cross section of the posterior duct at **7,** showing the blind ending of the tubules.

75. A longitudinal section of the fold at **5,** showing only one of the central canals.

76. The same, the under side of the lumen being in focus.

77. A longitudinal section near **3**; here also one of the canals has been cut away.

78. Peritoneal cells of the nephridial supporting covering from *p. c.* fig. 59.

79. The same, end view. *p. c.* masses of perigastric cells.

80. One of the perigastric cells more highly magnified.

81. One of the spermathecæ, exterior view.

82. Cross section of a spermatheca. *a.* upper sac-like part. *b.* lower muscular part. *m.* muscular layer of the sac-like part. *l. m.* longitudinal muscular layer of the body-wall. *c. m.* circular muscular layer of the spermatheca. *gl. ep.* glandular epithelium. *i.* inner cavity of the spermatheca. *sp. b.* sperm balls. *l. s.* lacunary system, or chambers for the storage of the spermatozoa. *s. m.* secreted mass with streaks of spermatozoa. *spz.* spermatozoa. *t. m.* transverse muscular layer of the body-wall. *spth. p.* spermathecal-pore.

83. A longitudinal section of the spermatheca more highly magnified, showing the lacunary system and its position to the epithelial cells. Letters as in the last figure.

84. Cross section of the muscular part of the spermatheca, showing the arrangement of the storage chambers occupied by sperm balls. Letters as in fig. 83.

85. One of the sperm balls more highly magnified. Of these never more than one occupies the same chamber.

86A. A somewhat diagramatic view of the anterior somite, composed from several sections, in order to show the location of the organs, their relative size, etc. *cl.* clitellum. *br.* brain. *c.* lower commissure of ventral ganglion. *phx.* pharynx. *sl. gl.* salivary glands. *œ.* œsophagus. *gz.* gizzard. *t. i.* tubular intestine. *s. i.* sacculated intestine. *nph.* cross section of the anterior nephridia in somites ii, iii, iv. The other nephridia are not shown. *sph.* spermathecæ. *sps.* sperm-sacs. *l. sps.* lobed sperm-sacs in xii. *ov.* ovary. *ovd.* oviduct. *c. r.* ciliated rosettes. *sp. d.* spermduct; the connection with the ciliated rosettes not shown. ♂ male pore. *pr.* prostate. *p. s.* sacs with penial setæ opening in the same pore, but more ventrally than the prostate. *e.* the place where the spermduct enters the prostate.

86B. The body opened from above and the interior organs exposed to view. A partially diagramatic view. The dotted lines indicate the organs covered by others, and which could not be seen except by removal of overlying organs. Letters indicate as in the preceding figure.

87A. Diagramatic longitudinal section of gizzard.

87B. Diagramatic transverse section of gizzard, to show its compressed shape.

88. A part of the epithelium and muscular layer of the gizzard seen in longitudinal section. *ep.* epidermis. *ept.* epithelium. *l. m.* longitudinal muscles.

89. A transverse section of the gizzard. (Letters as in fig. 88.)

90. A transverse section of the alimentary canal adjoining the gizzard posteriorly. *t. m.* transverse muscles. *l. m.* longitudinal muscles. *ep.* epithelium cells. *chy.* supposed chylus chambers. *c. c.* chloragogic cells. *gl.* glands. *bl.* bloodvessels.

91. The same in longitudinal section. (Letters as in fig. 90.)

92. Surface view of the same, showing the arrangement of the chylus chambers. (Camera drawing.)

93A. Section of a part of the dorsal vessel in somite xvi. *m.* muscular layer. *bl.* blood clot. *c. c.* chloragogic cells.

93B. Section through the alimentary canal in somite xiv.

94A. One of the testes.

94B. Right testis in cross section.

94C. Left testis in the same somite xi in cross section.

95. Ovary.

96. Section of the body in somite x, through testes.

97. Section of the body in somite x through the sperm funnels, very close to the septum.

98. Section through somite xi.

99. Section through somite xii. *sps. x.* sperm sac in x. *sps. xi.* sperm sac in xi. *sps. xii.* sperm sac in xii. *m.* longitudinal muscles connecting various organs with the body-wall. *i.* intestine. *d. v.* dorsal vessel. *v. v.* ventral vessel. *h.* hearts. *t.* testes. *v. gl.* ventral ganglion. *s.* septum.

100. Part of the sperm-sac. *coc.* parasitic coccidiæ.

101. One of the sperm-sacs separated.

102. Oviduct *a* and *b*, front view. *c.* side view of an abnormal oviduct with two, instead of one, upper lips. *u. l.* upper lip. *s.* septum. *m.* muscular band.

103A. Cross section of the body-wall through the male-pore, showing sections of prostate and penial setæ. *pr. gl.* sections of glandular part of prostate. *pr. m.* muscular part of prostate. *p. s.* penial setæ and their sacs. *v.* vascular layer of the body-wall. *l. m.* longitudinal layer of muscles. *t. m.* transverse layer of muscles. *c. gl.* glandular layer of clitellum. *h.* hypodermis. *g.* ganglion. *v. p.* ventral part of the worm.

103B. Detail of former, nuclei in the muscular part of the prostate.

104. One of the ciliated funnels freed from the attached sperm-sacs.

105. Diagramatic section through prostate, showing relative size of spermducts where they join the prostate.

106. Diagramatic representation of the prostate, showing its natural position when the body-wall is spread out. *pr.* glandular prostate. *spd.* spermduct. *p. s.* penis-sacs. *m. pr.* muscular prostate. *v. l.* vascular layer. *v.* ventral side.

107. Detail of the above, to show junction of spermduct and prostate.

108. Cross section of prostate. *bl. v.* blood vessels. *o. gl.* outer glands or prostate proper. *i. gl.* inner gland or atrium.

109. Detail of the former, showing the way the outer glands open into the atrium between the inner cell layer.

110, 111, 112, 113. Successive sections through prostate and spermduct, illustrating the junction of the two. In the first figure the spermducts have not yet entered the muscular part of the prostate. In the three following figures this junction is progressing, and finally almost accomplished. *i. m. l.* inner epithelium of the muscular part of the prostate. *pr.* glandular prostate. *spd.* spermduct. *bl. v.* blood vssels. *m. l.* muscular layer of the spermduct. In 110 the spermduct has been sectioned twice, as it is here convoluted.

114. Cross section through the body-wall in somite xix. *v. l.* vascular layer. *l. m.* longitudinal layer of muscles. *t. m.* transverse muscles. *h.* hypodermis.

115. Cross section through clitellum. *gl.* glandular cells with fine secretions. *c. gl.* glands from the hypodermis projecting into the former layer. *bl. v.* blood vessels.

116. Detail of the former, illustrating the hypodermal glands, etc.

117. Cross section through body-wall, somite xii. Letters same as above, illustrating the arrangement of the longitudinal muscles. *spd.* spermduct.

118. Cross section through body-wall somite xvii, illustrating the transverse muscles.

119. Somite xiv laid open, illustrating the diagonal muscular band. *ovd.* oviduct. *s.* septum xiii/xiv. *ovp.* ovipore. *1. 2. 3. 4.* setæ. *m. 1. 2. 3.* diagonal muscular band, beginning and ending on the body-wall. *m. 4.* muscular band connecting the oviduct and septum with the body-wall. *n. f.* nephridio-funnel. *is. g.* intersegmental groove. *v. v.* ventral blood-vessel. *h.* ventral part of the hearts. *l. v.* lateral vessel spreading on the body-wall and supplying the nephridium. *v. g.* ventral ganglion.

120A. Cross section through one of the ventral papillæ of Argilophilus marmoratus papillifer. *t. c.* tubular cells butting on the central glandular masses. *c. gl.* supporting and protecting cells, with coarse grainy contents. *h.* common supporting cells of the hypodermal layer. *l. m.* longitudinal muscles. *t. m.* transverse muscles. *v. l.* inner vascular layer. *nf.* nerve ganglions, connecting the glandular masses with the ventral nerve ganglion. *o.* glandular papillæ with central nerve ganglia.

120B. The corresponding organ, or ventral papilla in Argilophilus marmoratus ornatus; letters indicate the same.

121A. Detail of the last figure showing the most lateral of the glandular masses. *o.* glandular masses with a central nerve ganglion.

121B. Detail of the same figure showing the most centrally located glands.

122. One of the common setæ.

123A. One of the penial setæ.

123B. The tips of the former more highly magnified.

124. A part of the body-wall viewed from the inner side. A semi-diagramatic figure illustrating the arrangement of the setæ and the nephridio-pores over a certain space. *1, 2, 3, 4,* the various rows of setæ. *np. p.* nephridio-pores, indicated by round circles. Two of the nephridia are drawn in order to show their position, as well as the relative size of the ducts.

125, 126, 127, 128. The anterior part of the body seen from the ventral side. Various specimens to show the variation in position and number of the ventral papillæ. *spth.* spermathecal-pores. *ovd.* oviducts. ♂ male-pores. The ovals indicate the ventral papillæ.

129A. The clitellar and some of the anterior somites, viewed from the ventral side, showing the various pores and the genital zone. Letters indicate the same as in the preceding figures. *p. s.* penial setæ protruding from the male-pores.

129B. The twenty-three anterior somites of a specimen killed in alcohol gradually increased in strength and hardened in strong alcohol, showing the spermathecal, ♀ and ♂ pores, the ventral papillæ, etc.

129C. The most anterior somites seen from above.

130. The two and three anterior somites of two different specimens, showing the inverted buccalic sac, the prostomium, etc. *a.* and *c.* ventral; *c. d.* and *f.* dorsal; *e.* lateral view.

ARGILOPHILUS MARMORATUS PAPILLIFER, Figs. 131–136.

131. The anterior somites viewed from below showing the single row of ventral papillæ, diminishing in size anteriorly. The outlines at the side represent the shape of the papillæ as found in the figured specimen.

132A. A medium size specimen preserved in strong alcohol. The specimen was first killed in an increasing solution of corrosive sublimate.

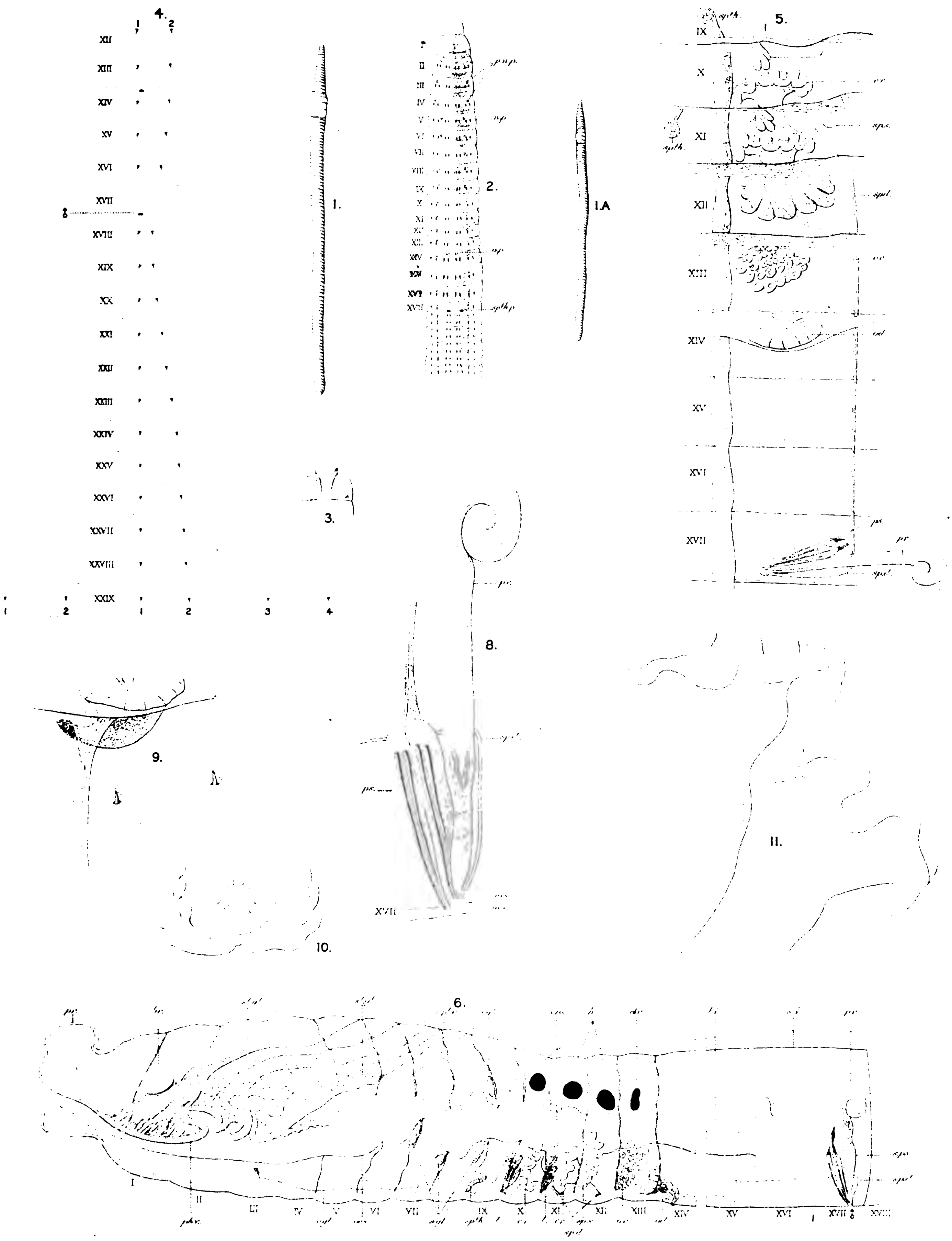
132B. A large specimen of the former figured while alive.

133. Section of the intestine and dorsal vessel in somite ix, in order to show the typhlosolar vessel. *t. v.* typhlosolar vessel in the intestine. *d. v.* dorsal longitudinal vessel. *ch. c.* chloragogic cells of the intestine. *e. p.* epithelial folds of the inner lining, void of chylus glands. *c. v.* the chylus region of the inner epethelial lining.

134. The typhlosolar region of the intestine, detail from the last figure more highly magnified. *t. v.* typhlosolar lining. *l. m.* longitudinal muscles of the intestine. *c. m.* circular muscular layer of the same. Other letters as in the last figure.

135. Cross section of the intestine and dorsal vessel in somite xxiv illustrating the typhlosole. *s. i.* sacculated intestine. *bl. s.* blood-sinuses. *ty.* typhlosole.

136. Detail of the former, showing the typhlosole proper, greatly magnified. *d. v.* dorsal vessel. *ty.* typhlosole. *bl. v.* blood sinuses in the intestine. *l. m.* longitudinal muscles. *c. m.* and *e. p.* circular muscles and epithelial lining of the intestine.



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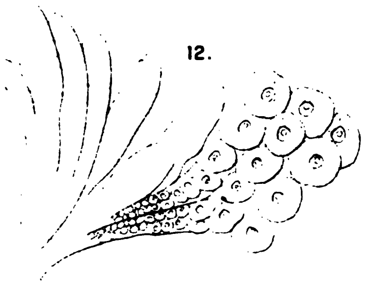
DELTANIA ELEGANS FIG'S. 1 TO 11.



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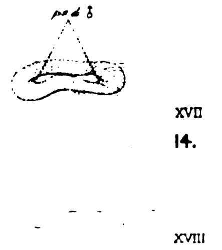

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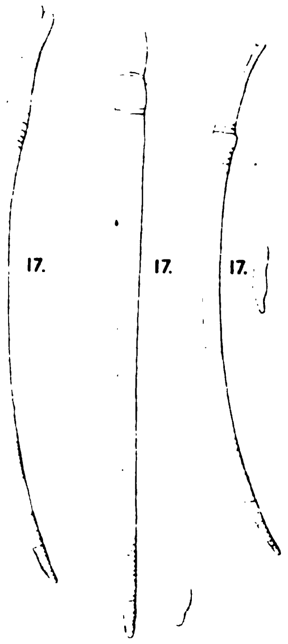

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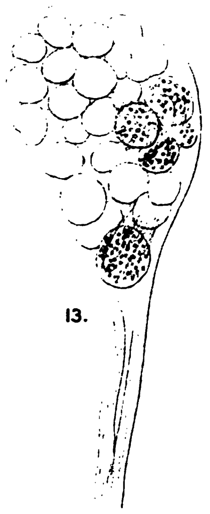

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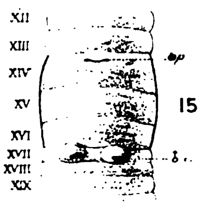

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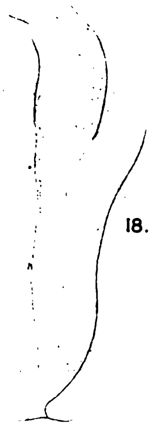

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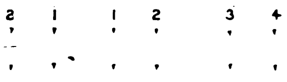

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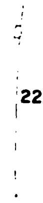

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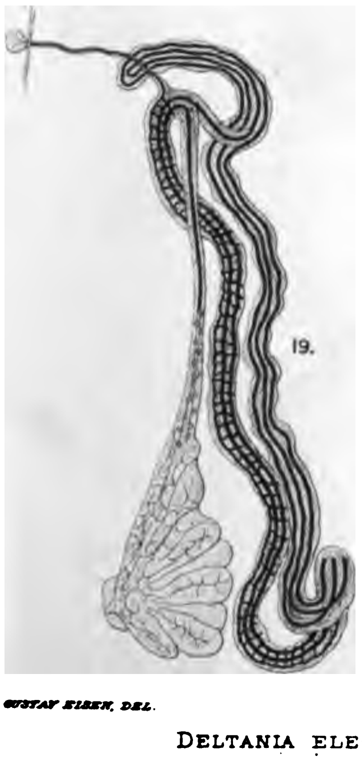

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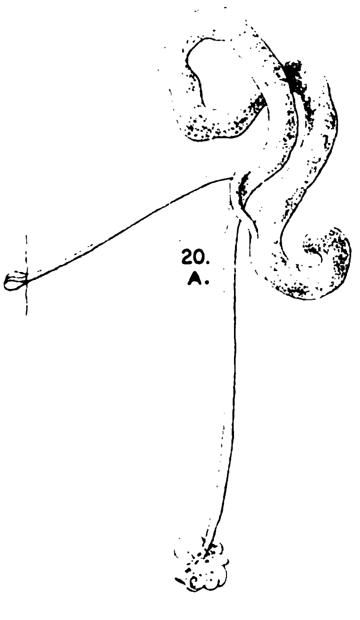

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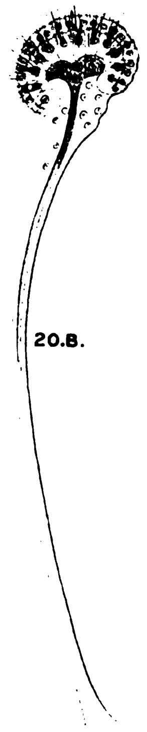

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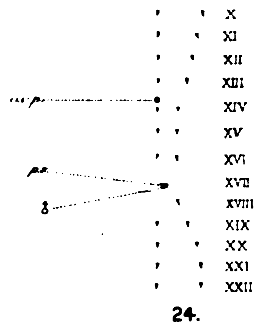

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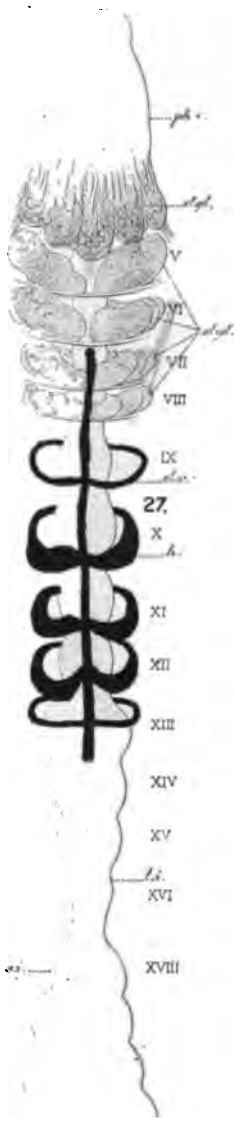
DELTANIA ELEGANS FIG'S. _12 TO 20. DELTANIA TROYERI FIG'S. _21 TO 24.



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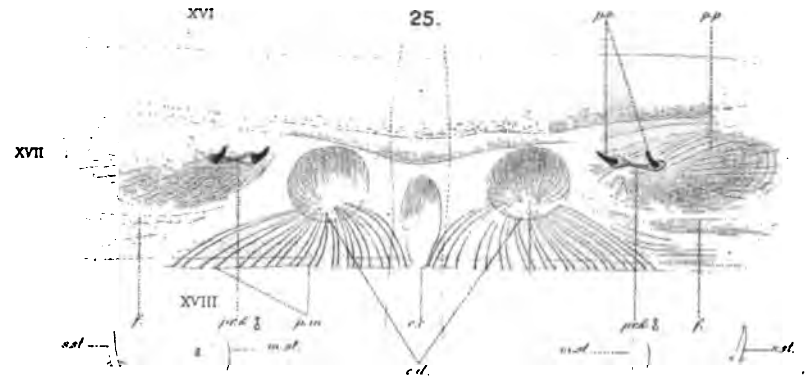

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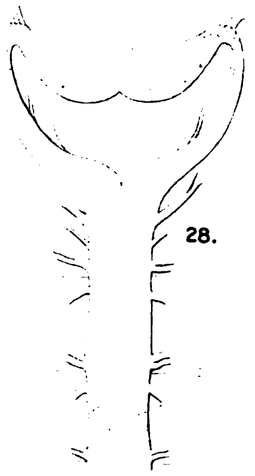

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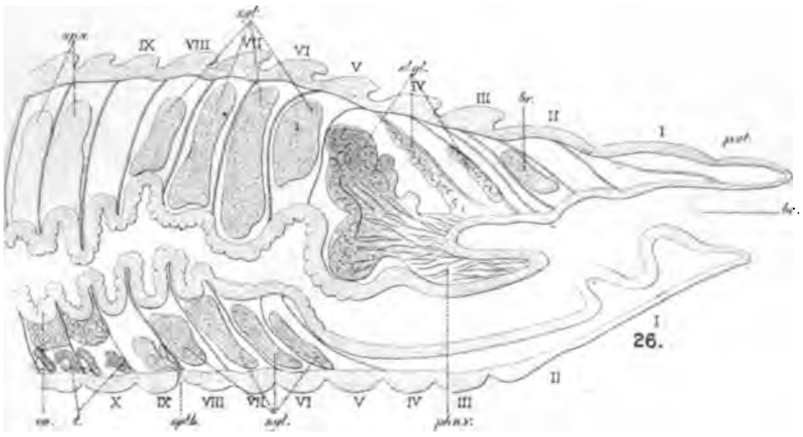

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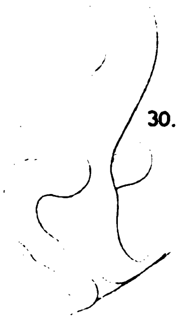

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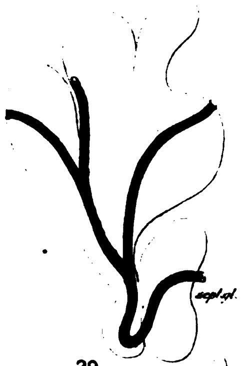

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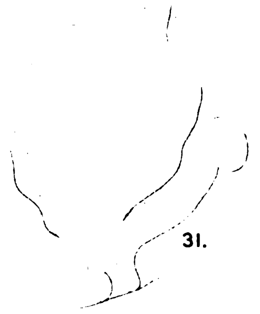

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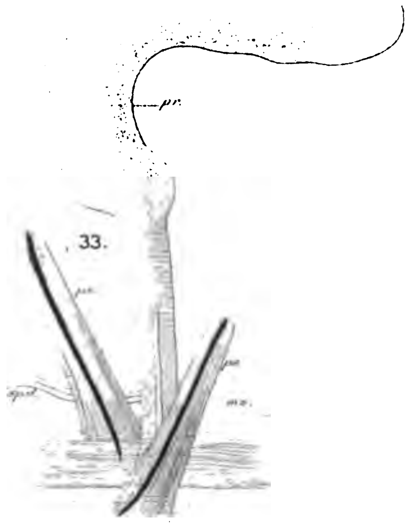

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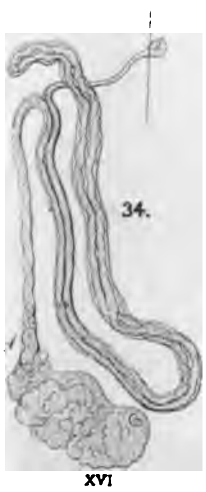

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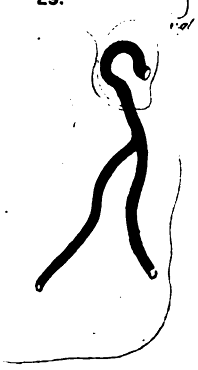

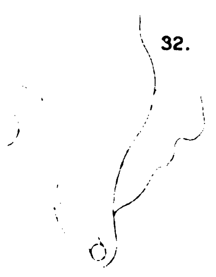

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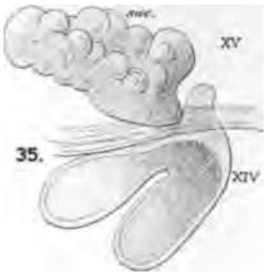
DELTANIA TROYERI FIG'S. 25 TO 34.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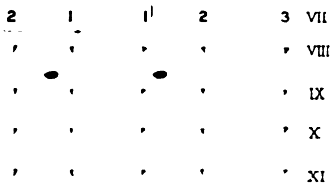
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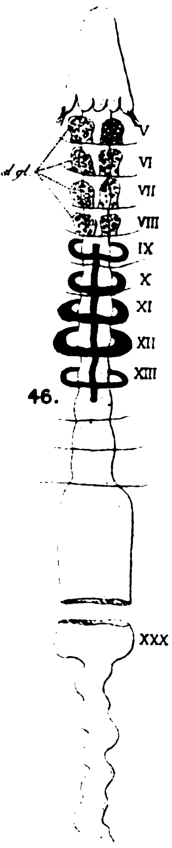
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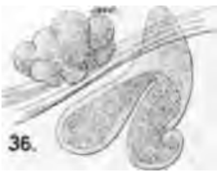
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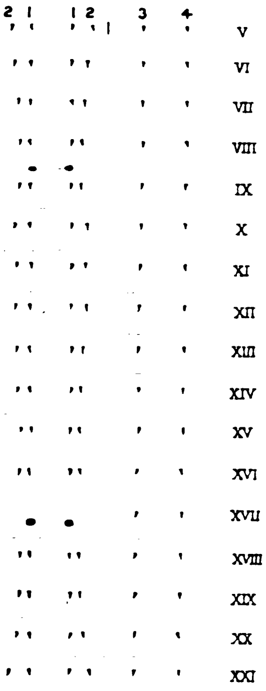
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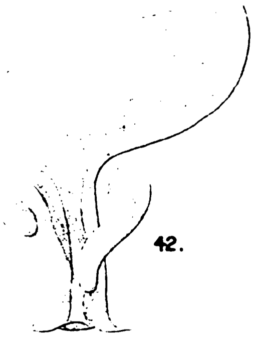
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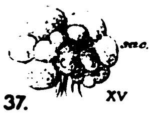
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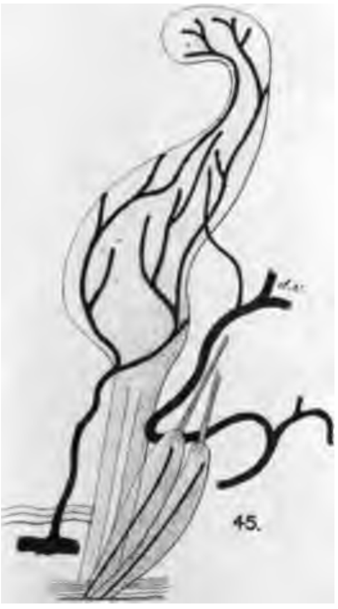
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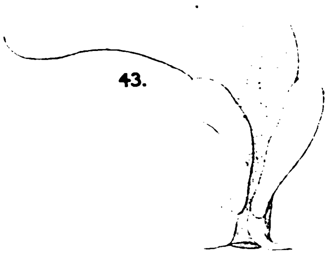
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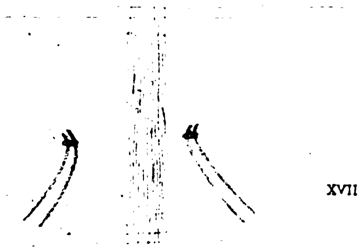
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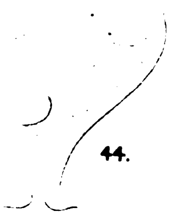
44.

GUSTAV EISEN. DEL.

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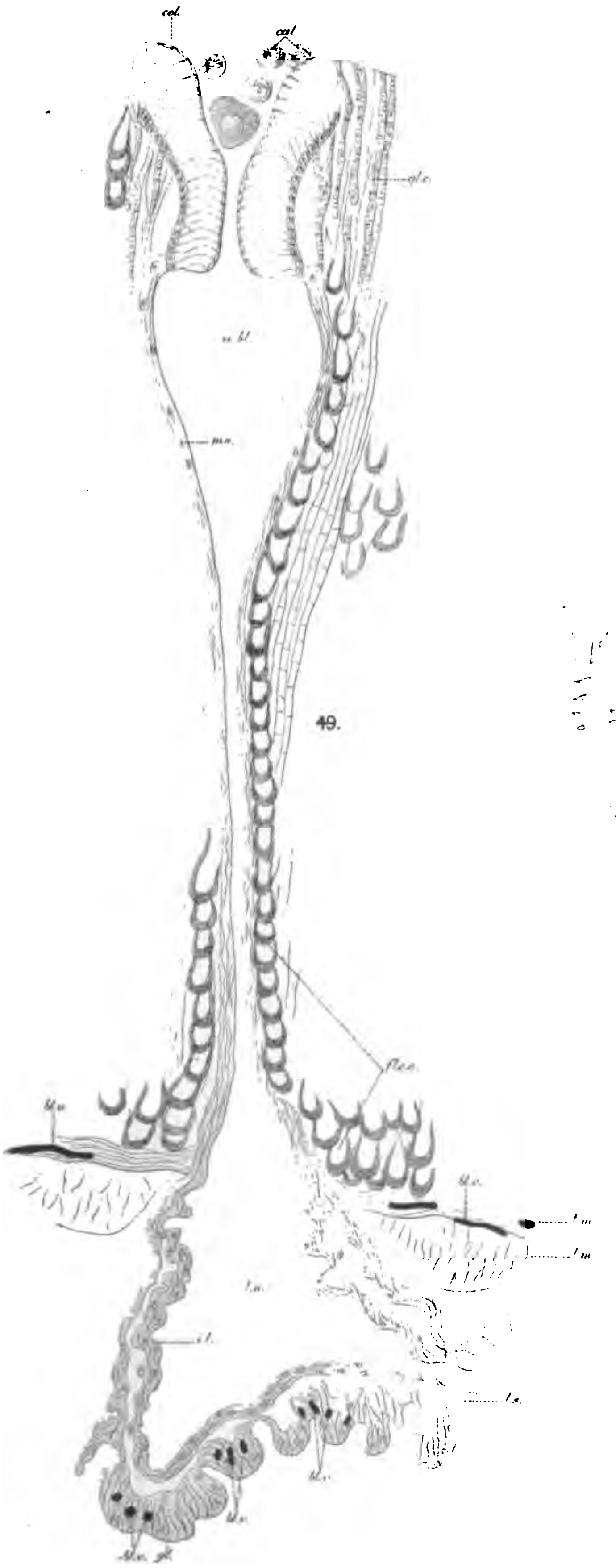
DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S. 40 TO 48.



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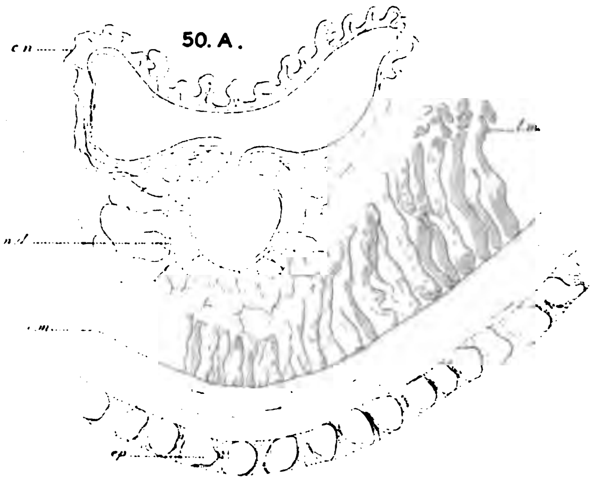
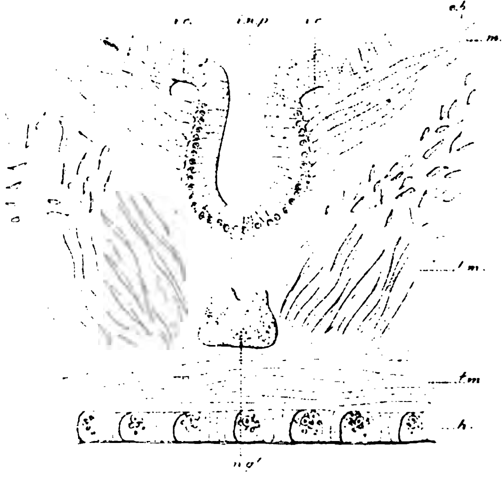
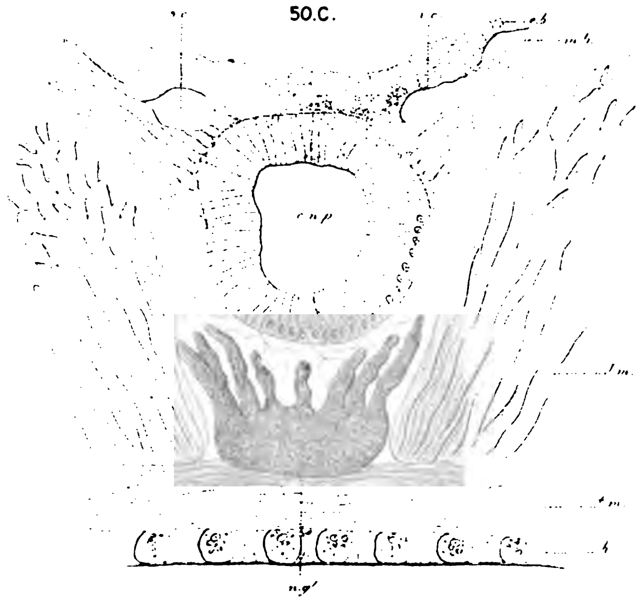
50. A.



50.B.



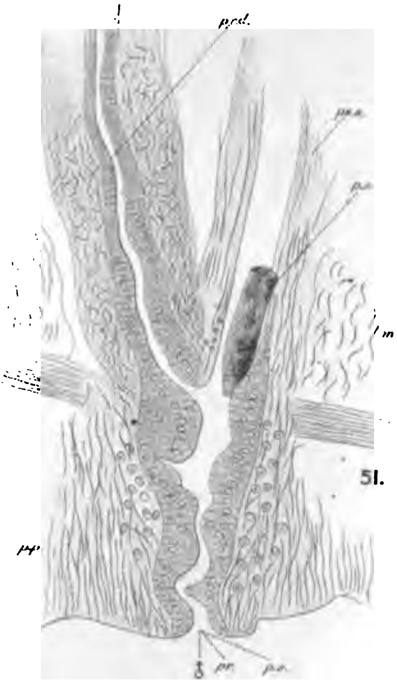
50.C.



GUSTAV EISEN, DEL.

LITH. BRITTON & REY S.F.

DELTANIA ELEGANS FIG'S. 49 & 50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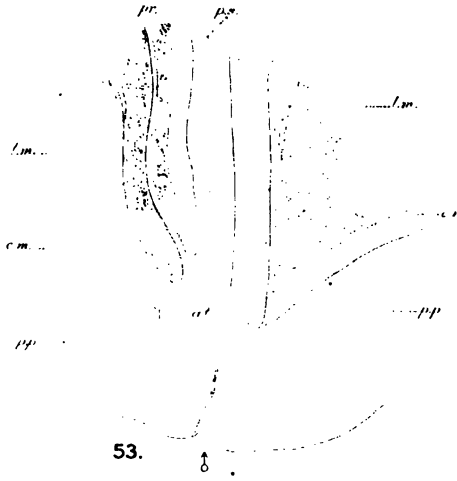
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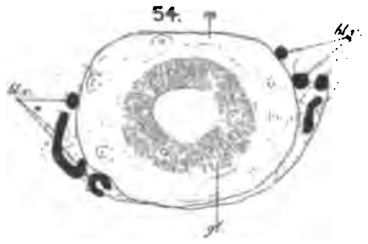
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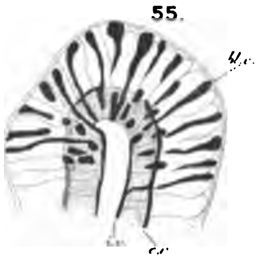
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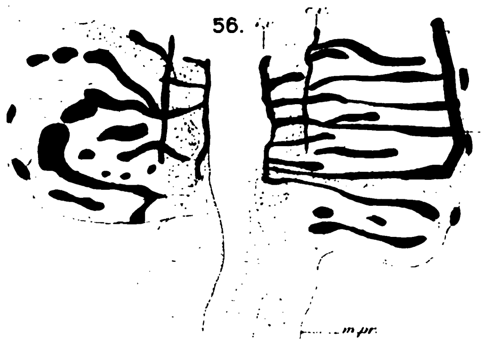
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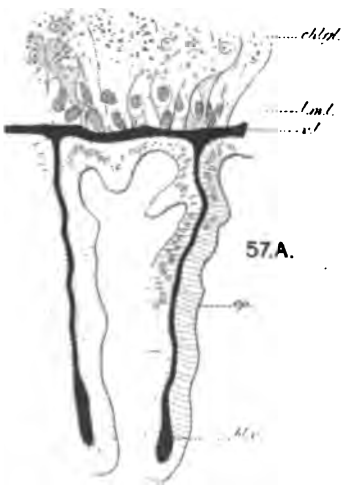
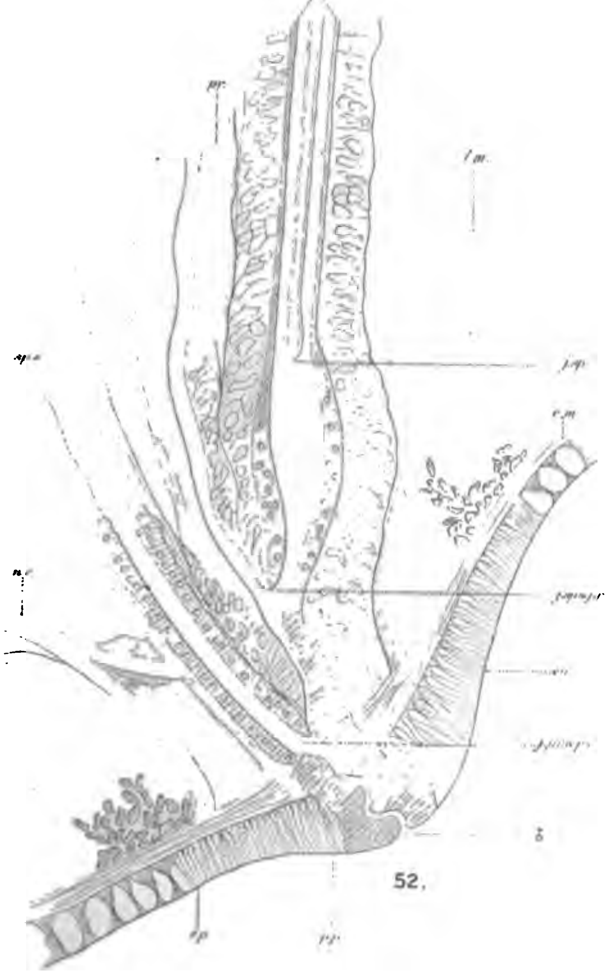

57.A.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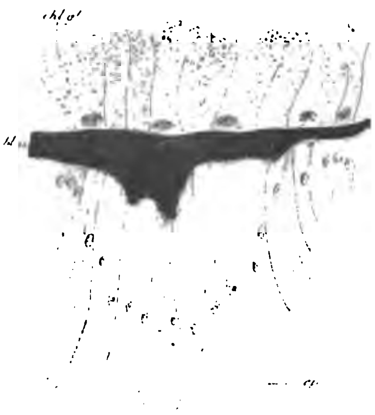
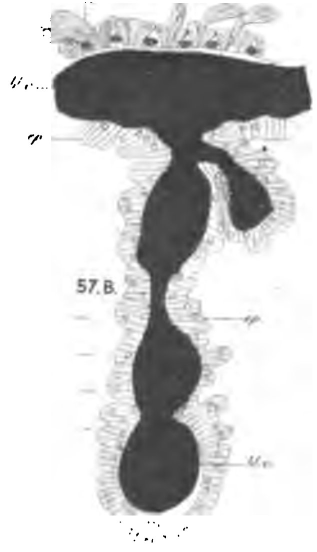

57.C.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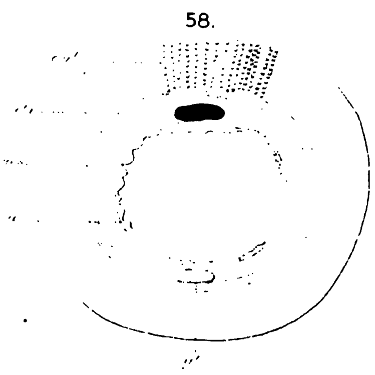
58.

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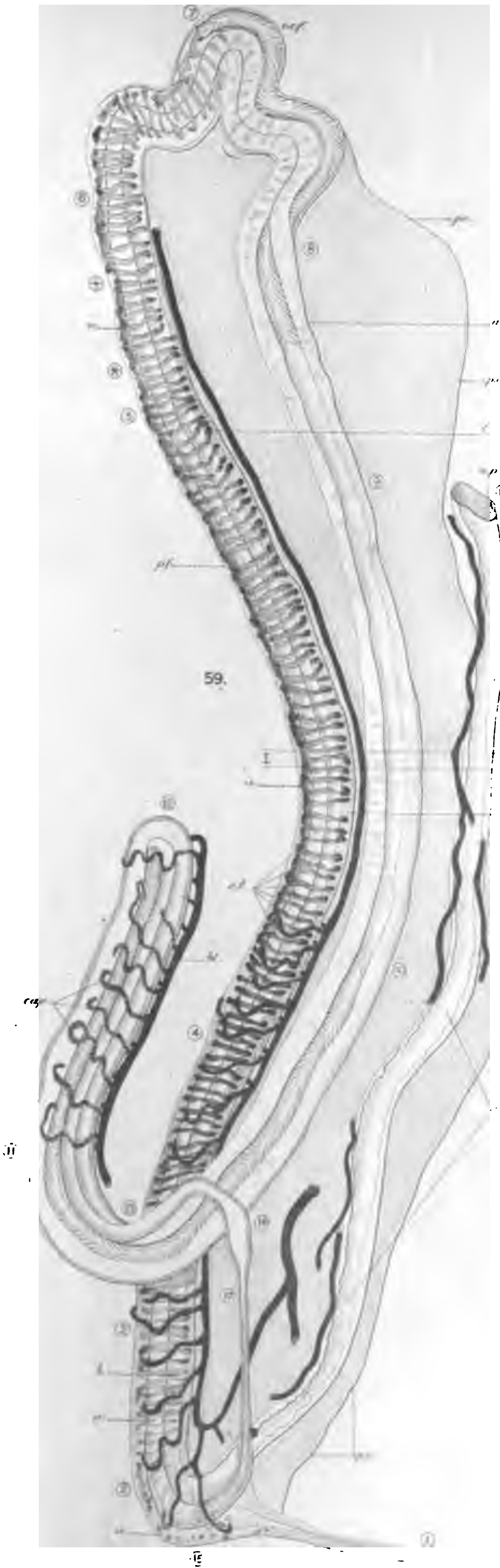
DELTANIA ELEGANS Figs. 51 to 58



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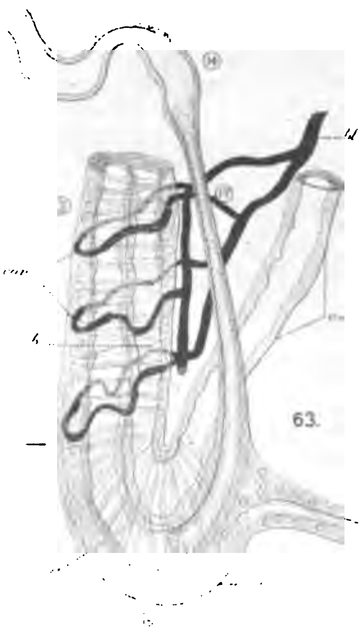
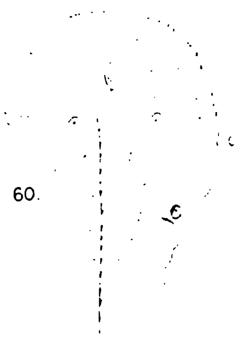
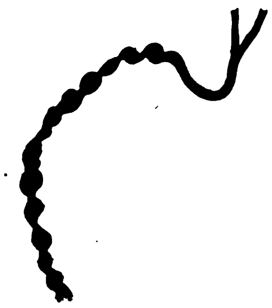




60.

61.A.

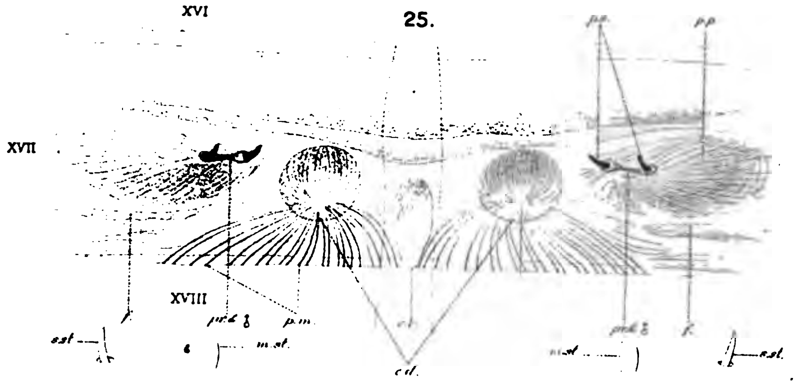
62.



61 B

GUSTAV EISEN DEL.

25.



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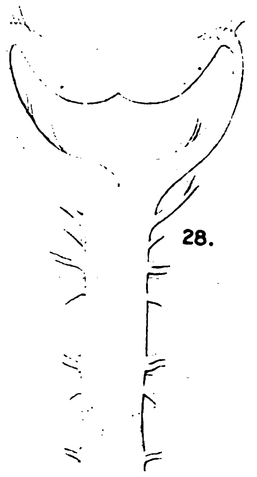

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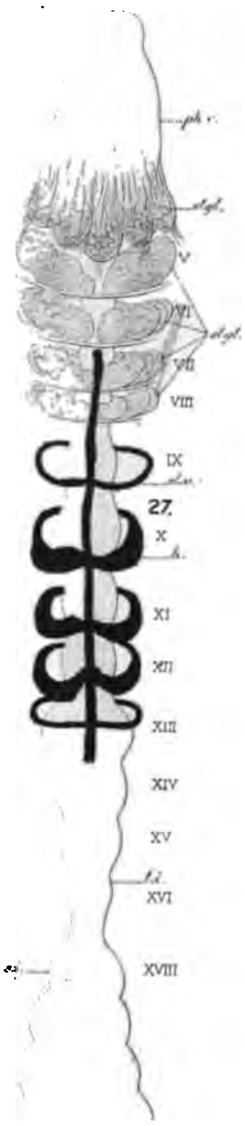

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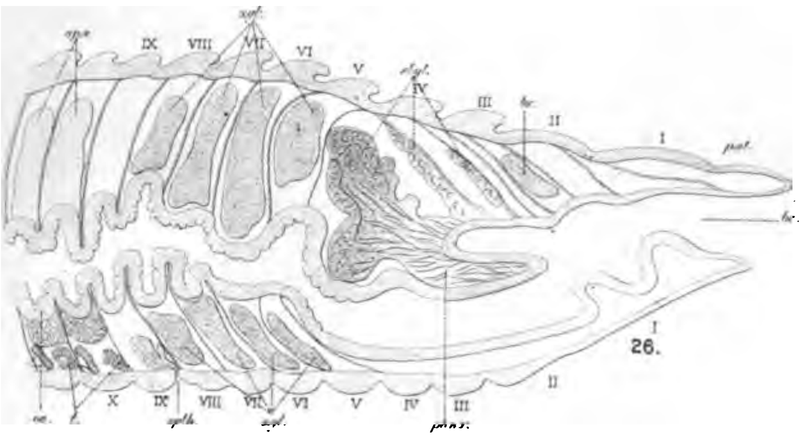

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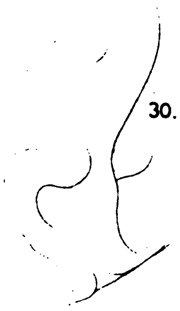

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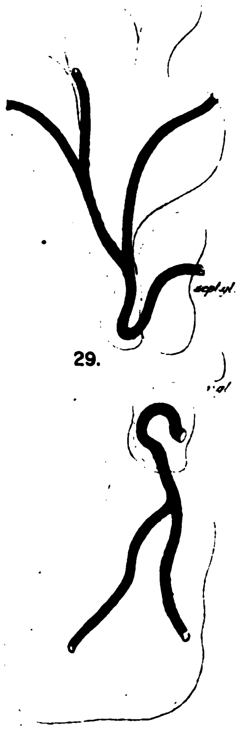

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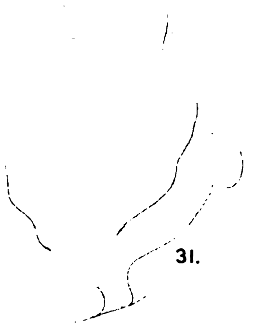

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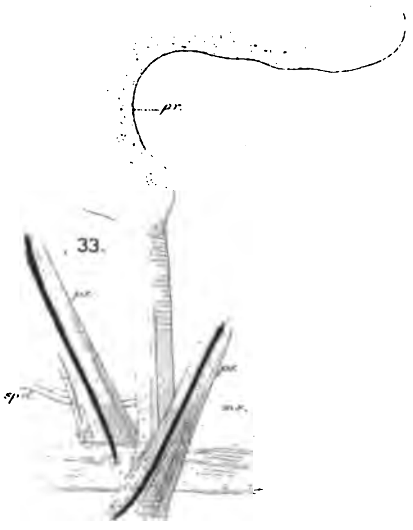
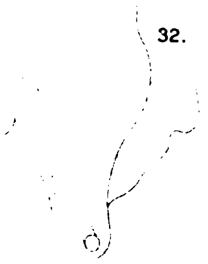


34.

32.



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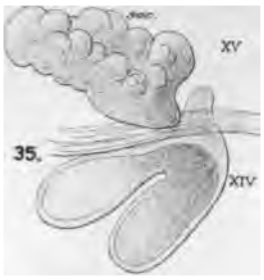
LITH. BRITTON & REY S. F.

DELTANIA TROYERI FIG'S. 25 TO 34.



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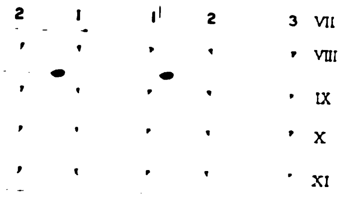

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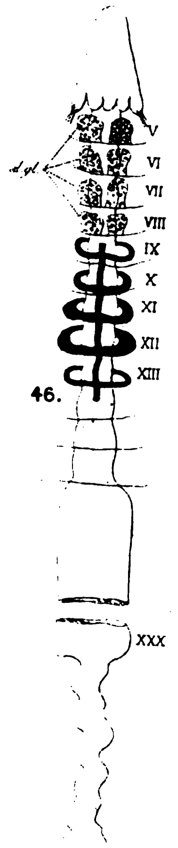

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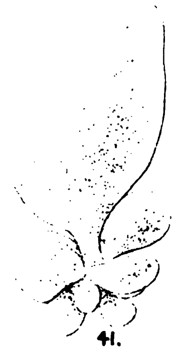

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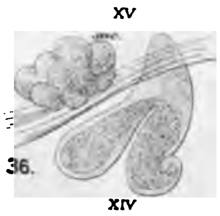

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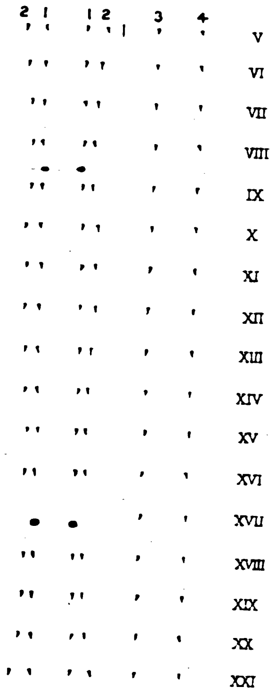

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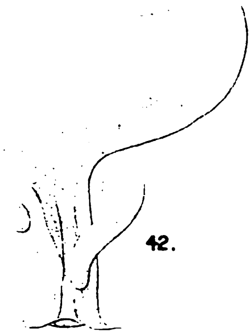

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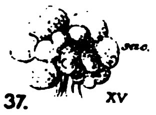

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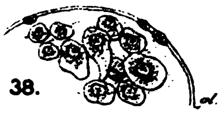

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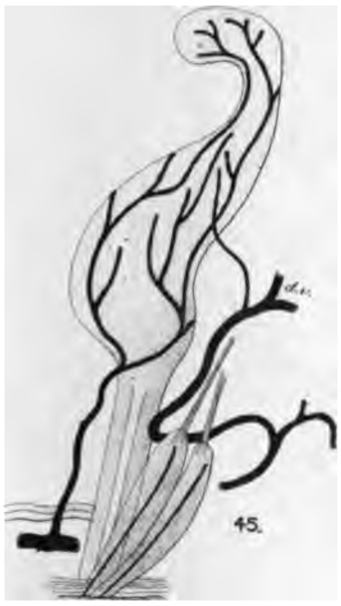

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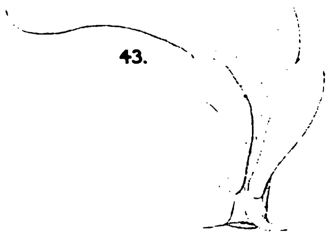

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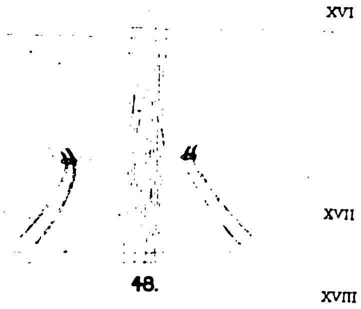

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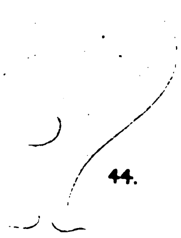
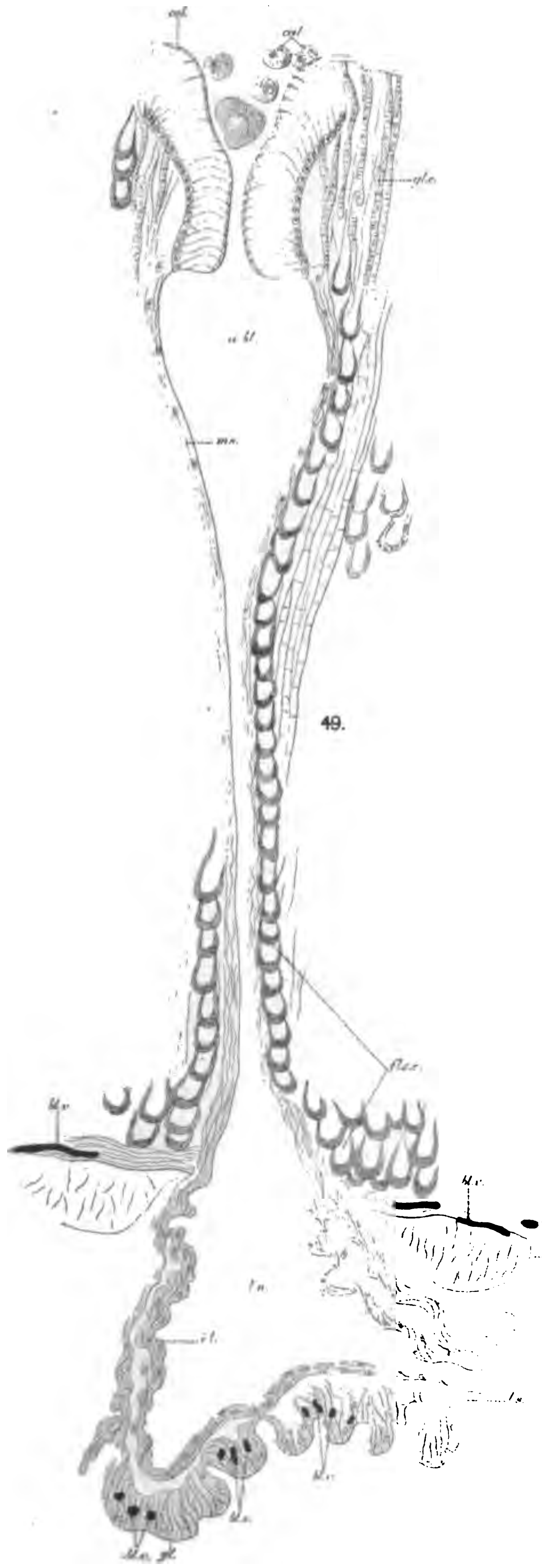


44.

GUSTAV EISEN, DEL.

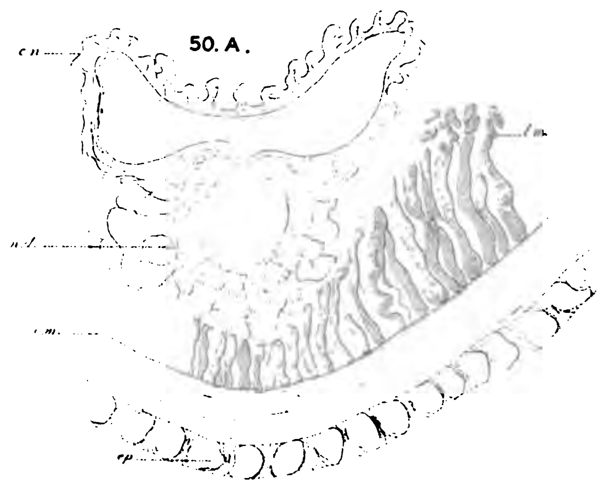
DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S. 40 TO 48.

LITH. BRITTON & REY S.F.

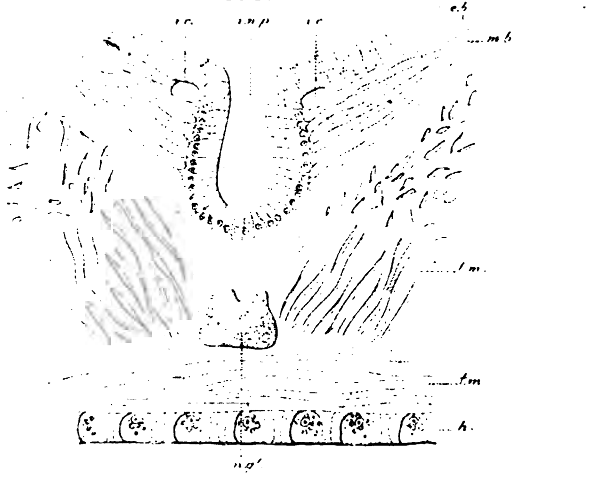


49.

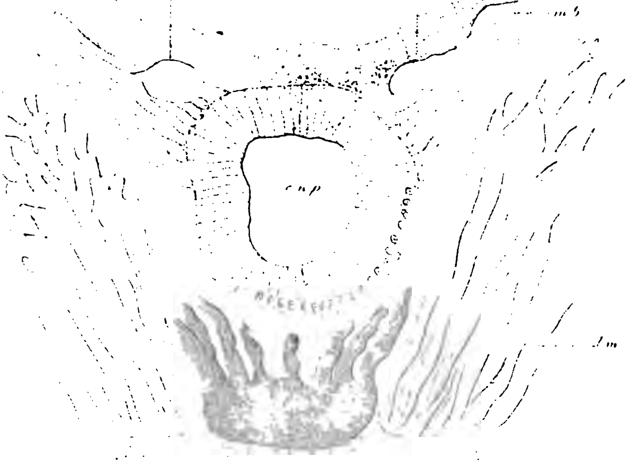
50. A.



50.B.



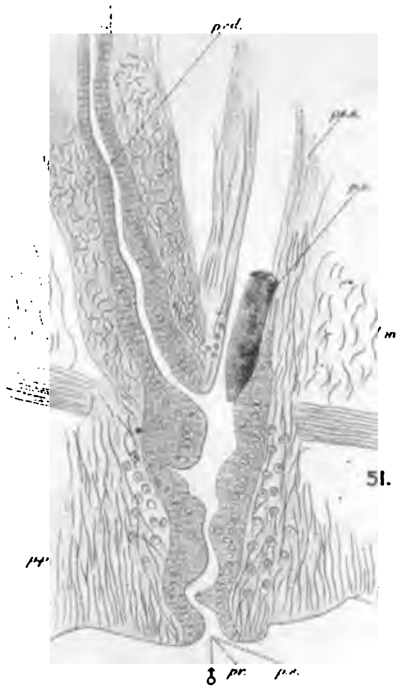
50.C.



GUSTAV EISEN, DEL.

LITH. BRITTON & REY S.F.

DELTANIA ELEGANS FIG'S. 49 & 50



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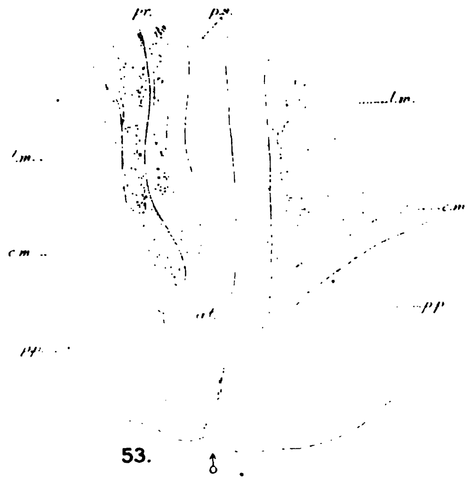

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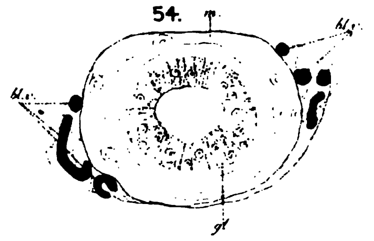

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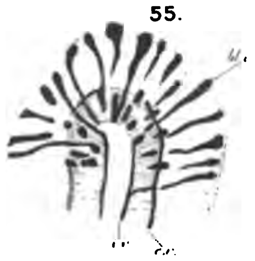

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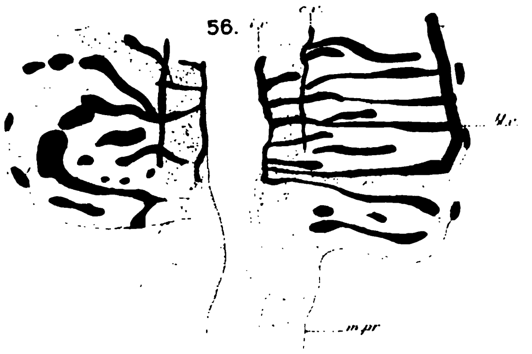
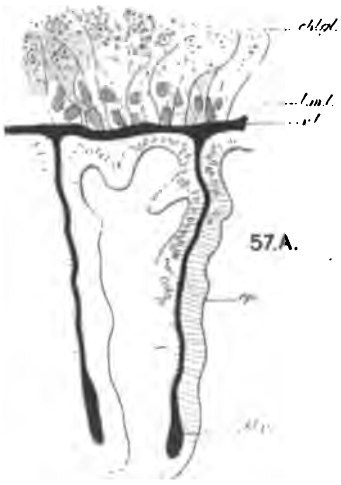
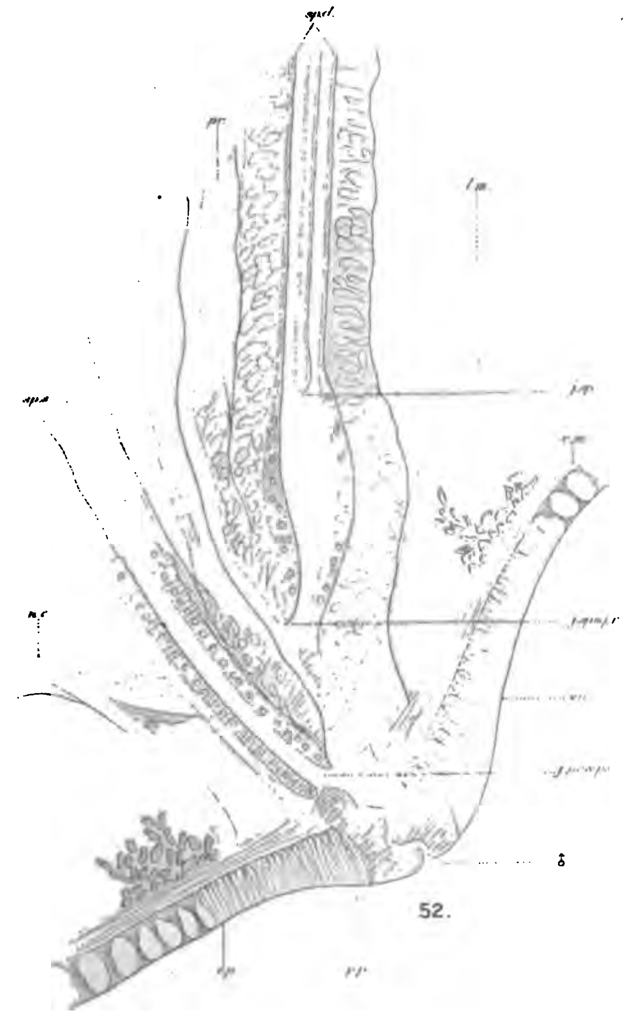




57.A.



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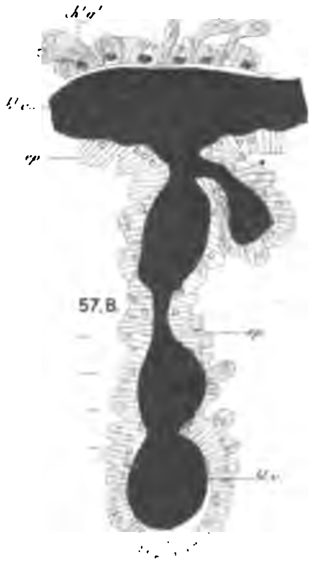
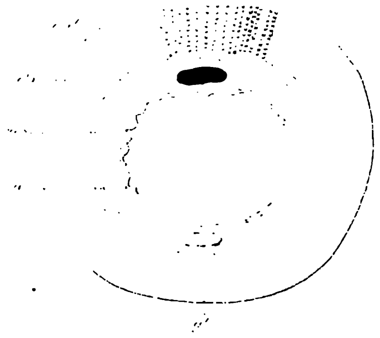
57.C.



57.B.

58.



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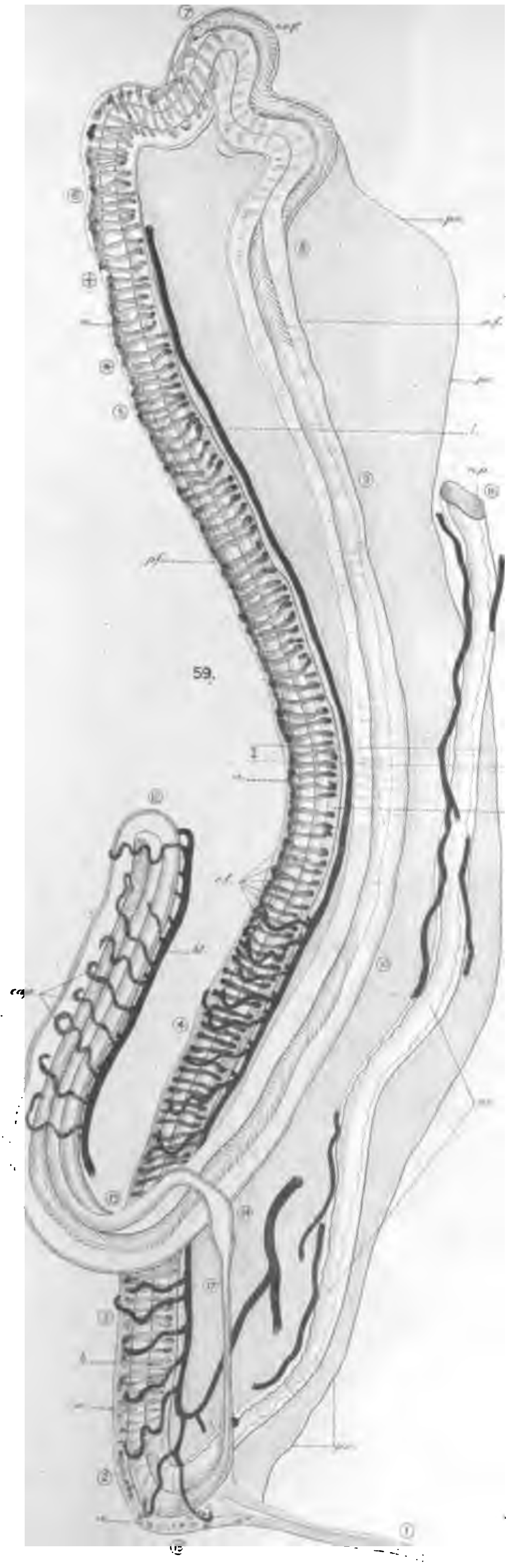
DELTANIA ELEGANS FIGS. [illegible]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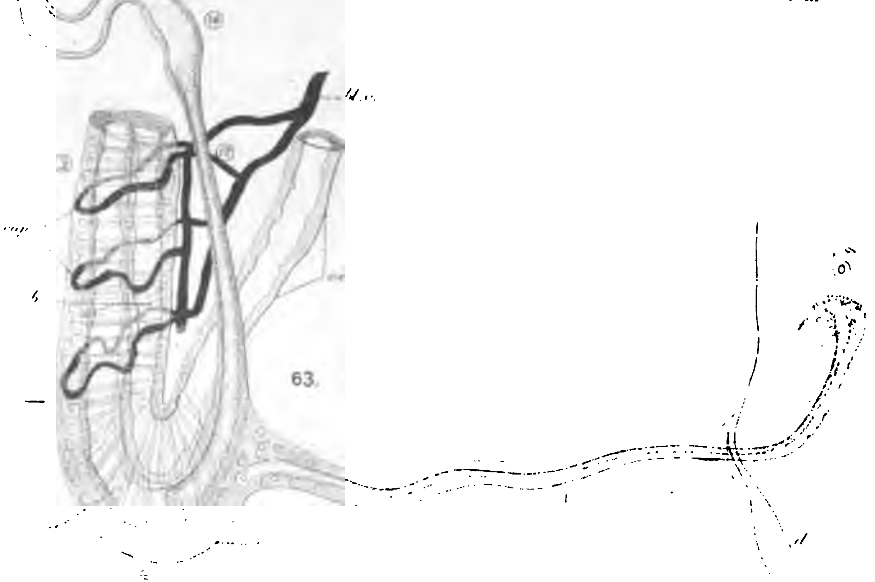
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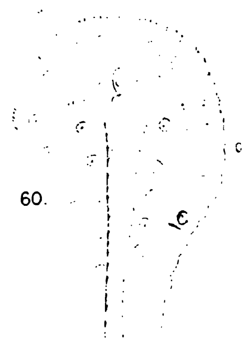
60.

61.A.

62.

61.B.

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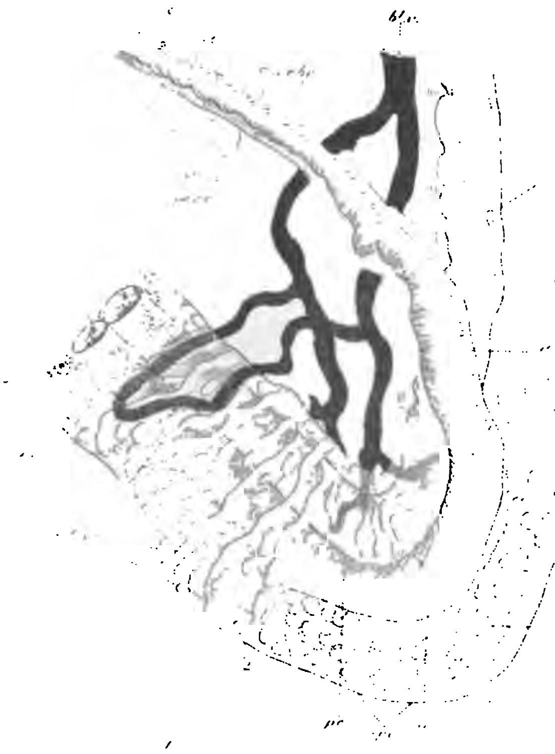
[illegible]



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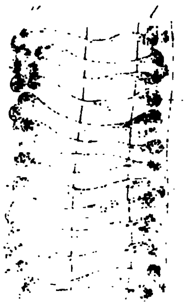

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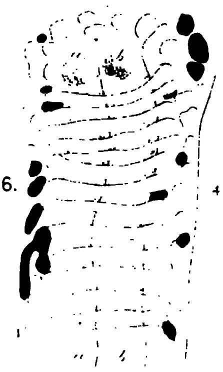

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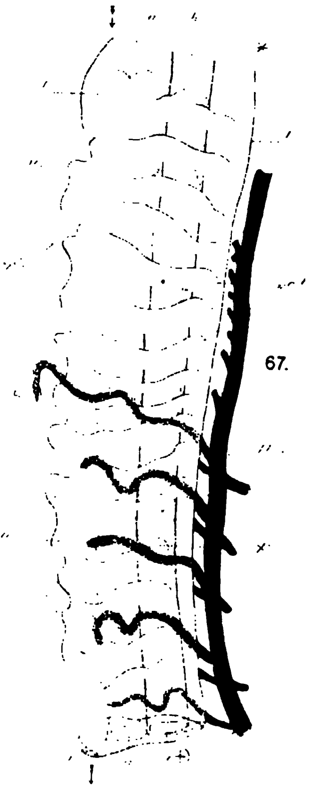

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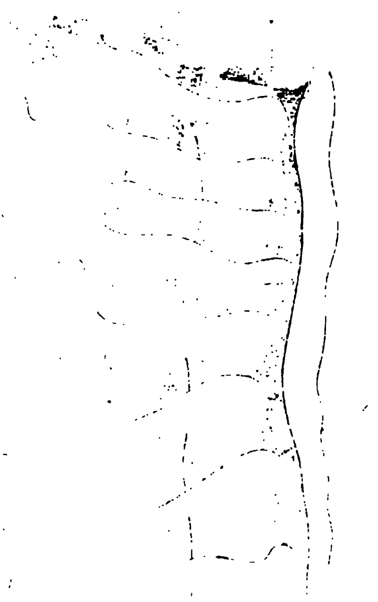
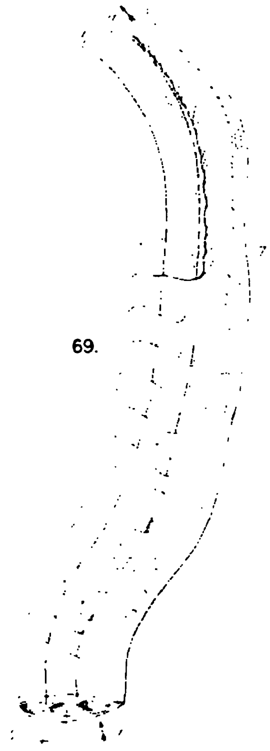


68.



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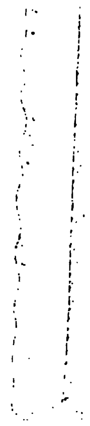

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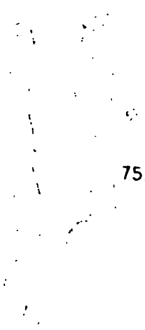

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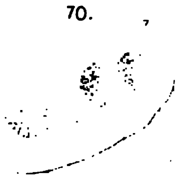

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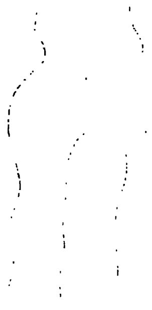

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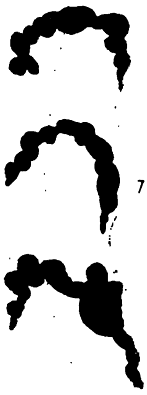
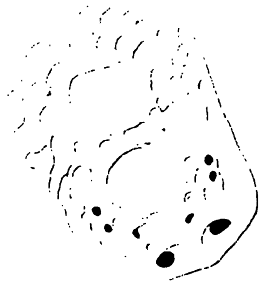
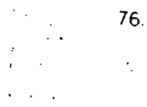


73.

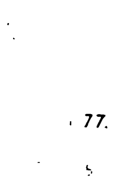
74A.



74.B.

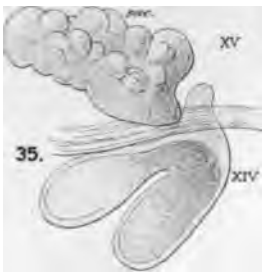


76.



77.

GUSTAV EISEN DEL.



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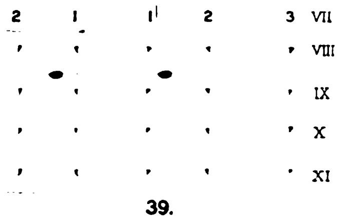

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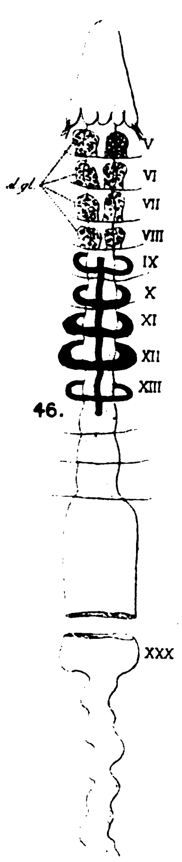

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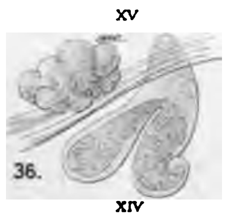

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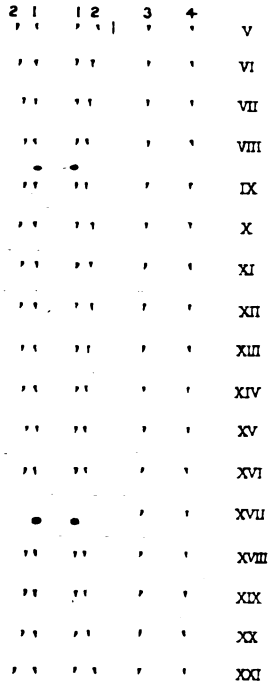

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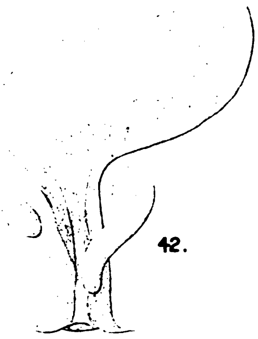

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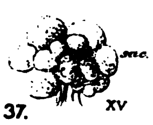

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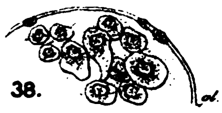

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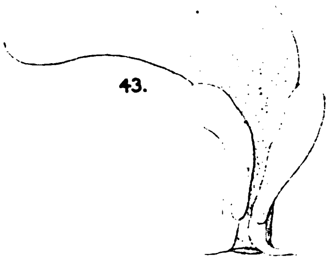

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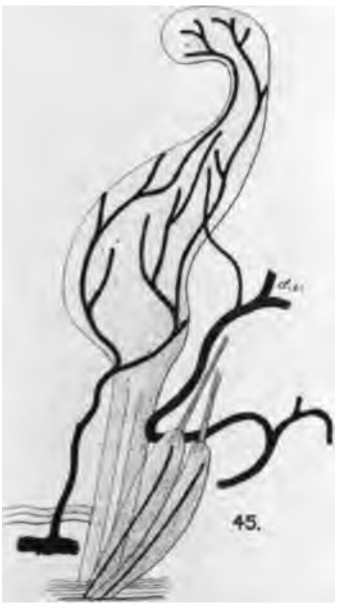

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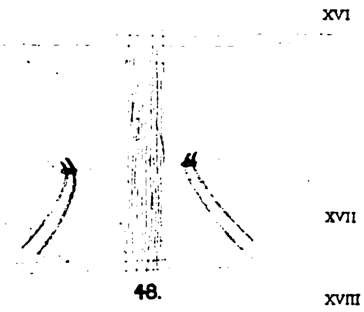

48.

47.

44.

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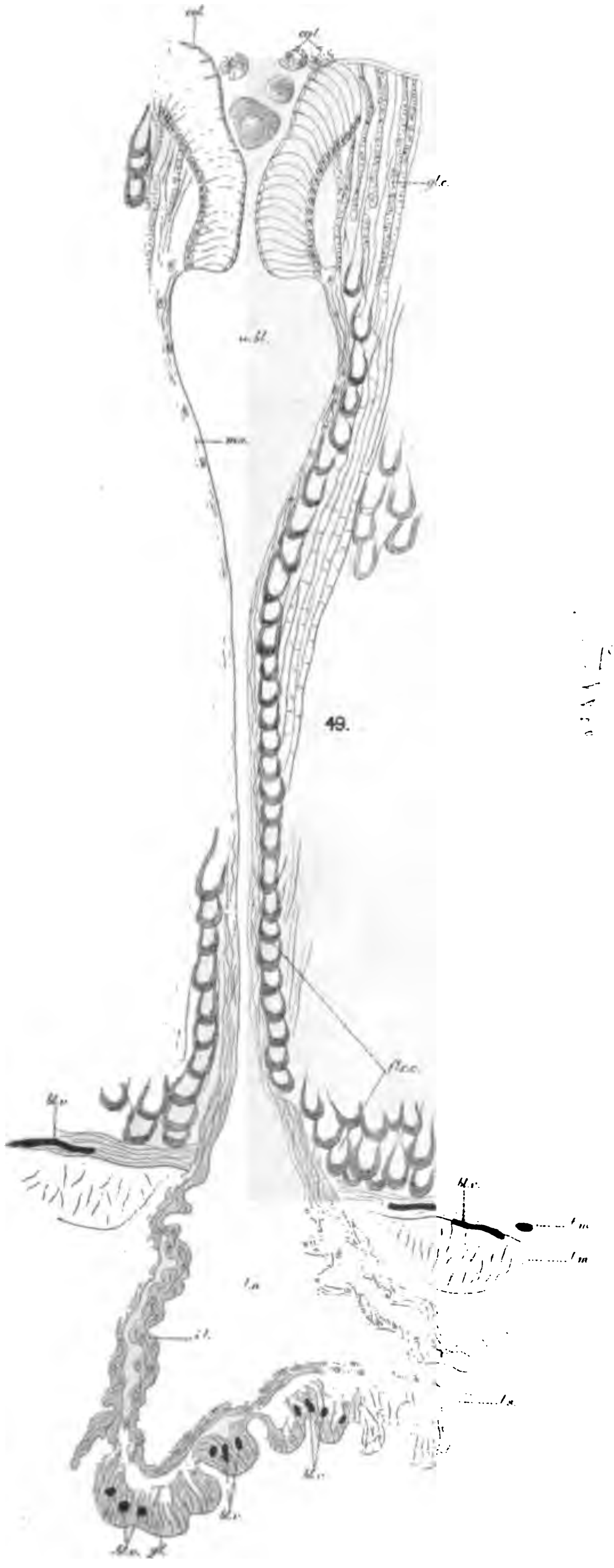
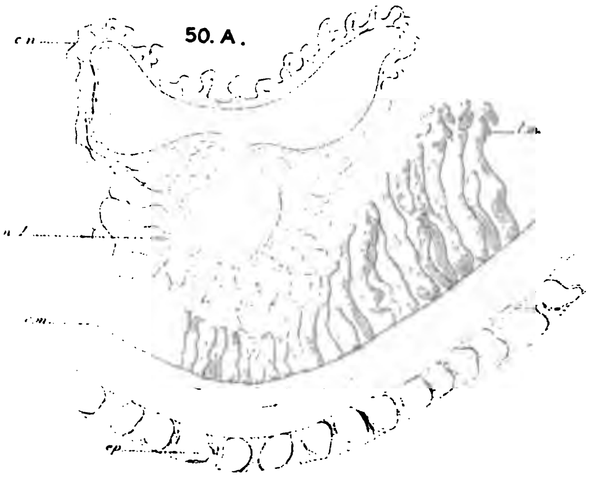
LITH. BRITTON & REY, S.F.

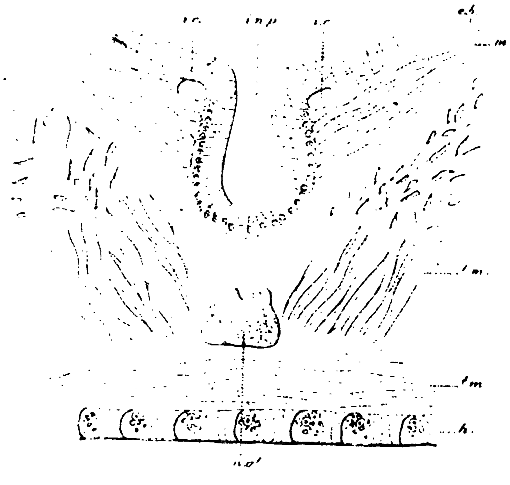
DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S. 40 TO 48.



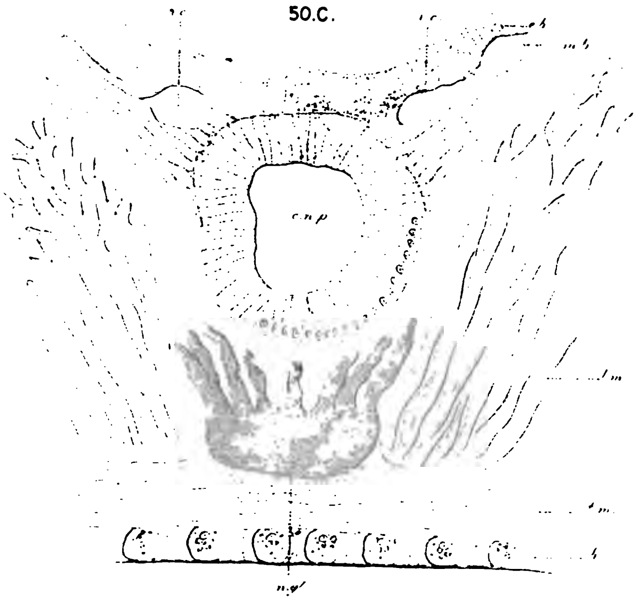
50. A.



50.B.



50.C.



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DELTANIA ELEGANS FIG'S. 49 & 50

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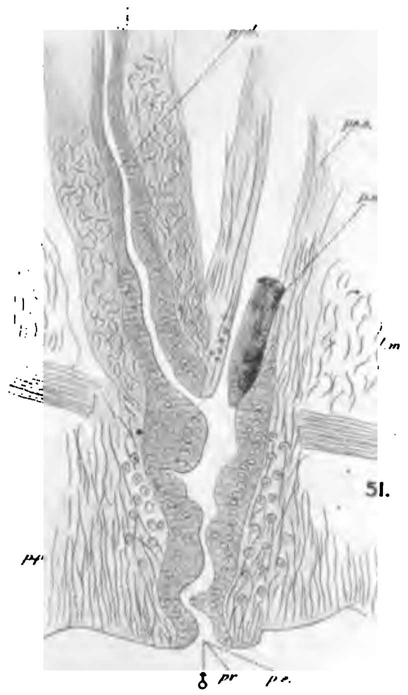
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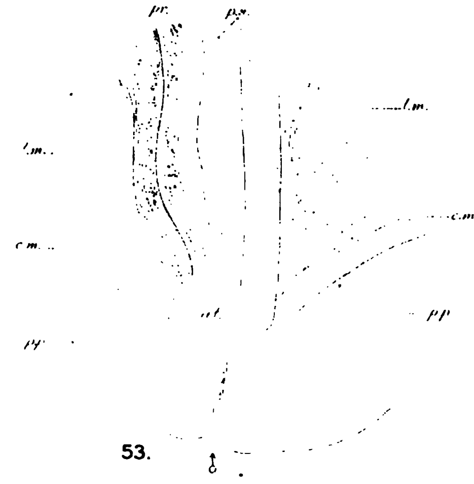
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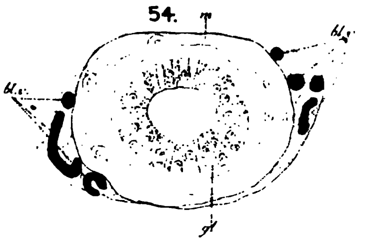
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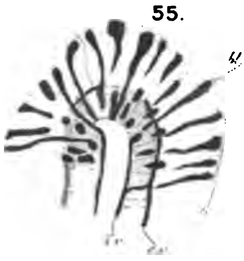
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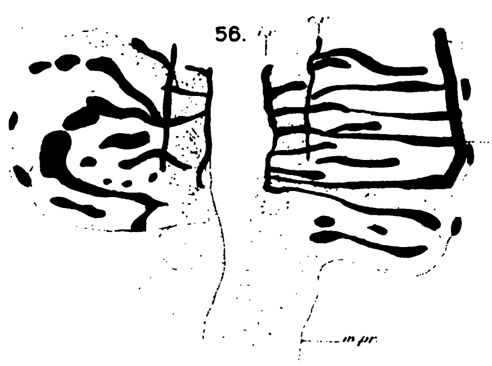
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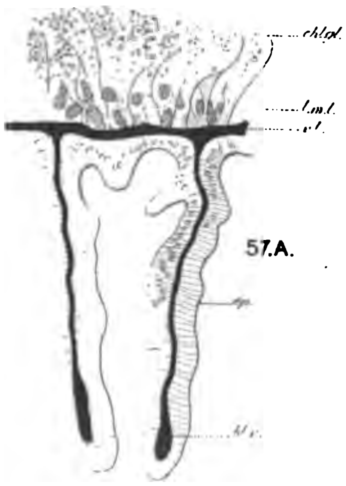
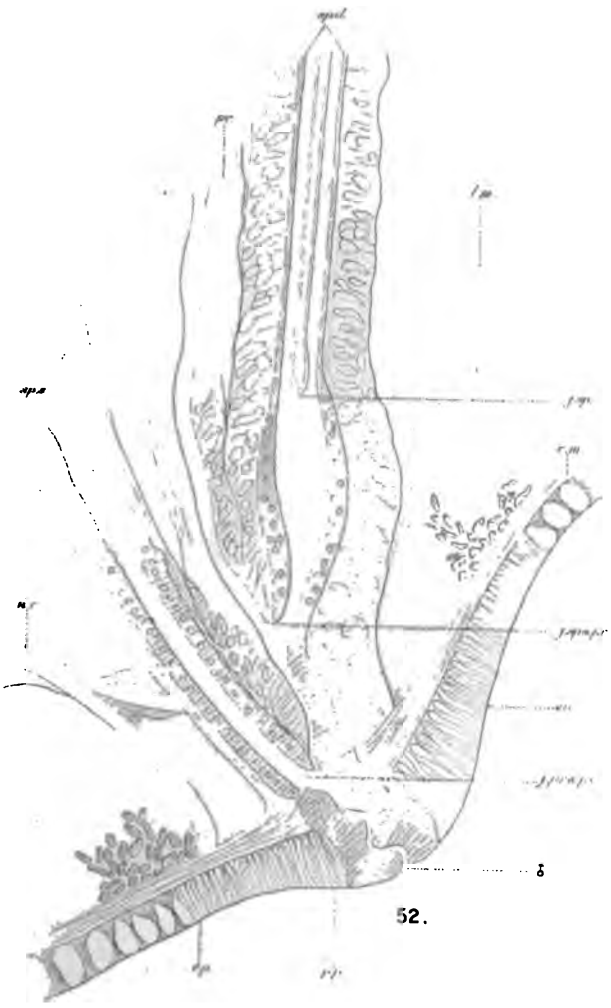

57.A.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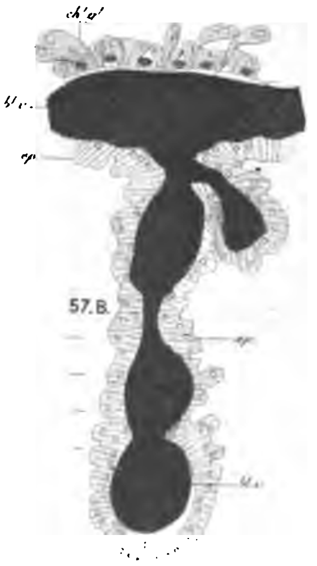
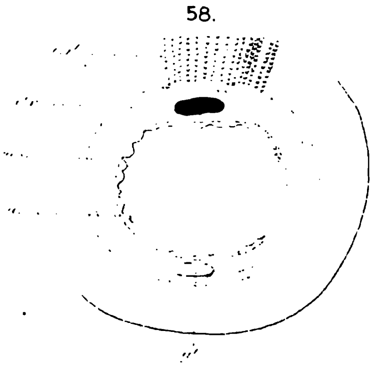
57.C.


57.B.


58.

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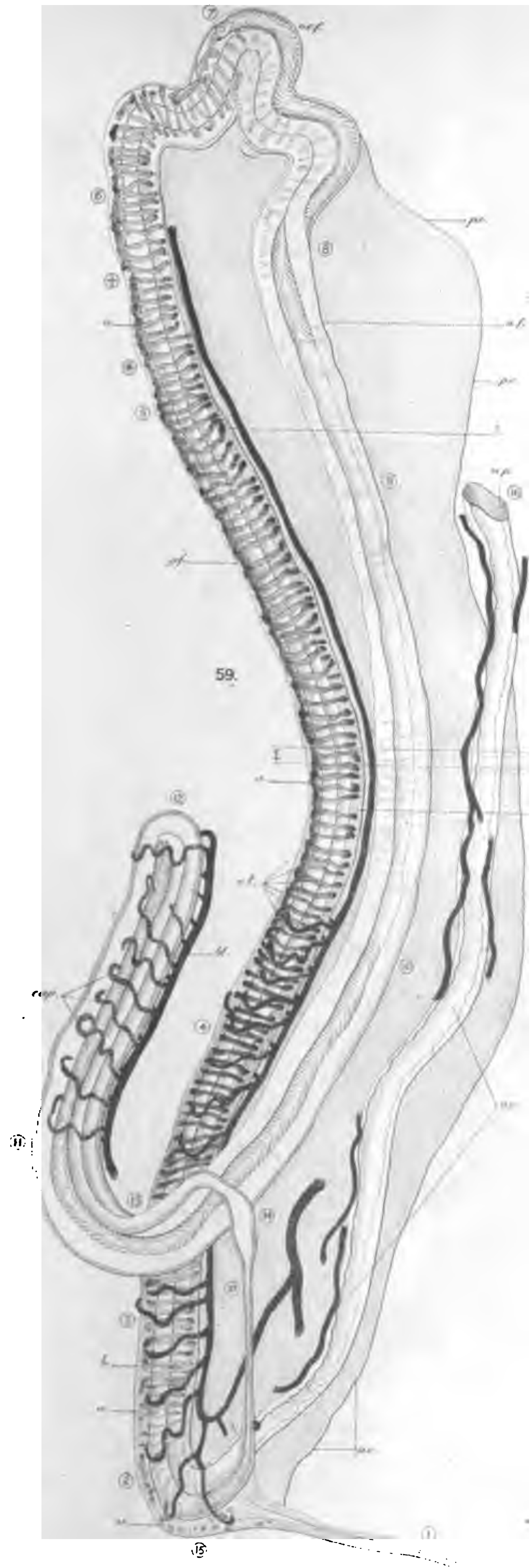
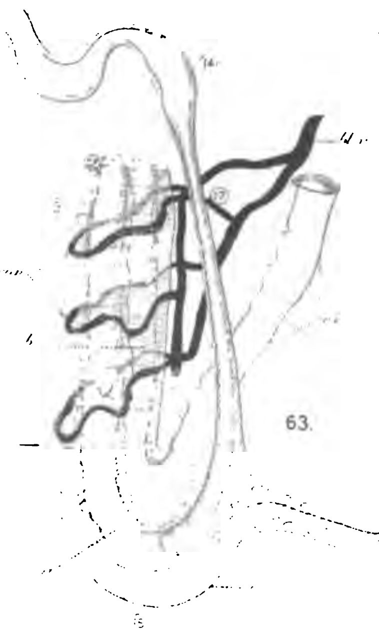
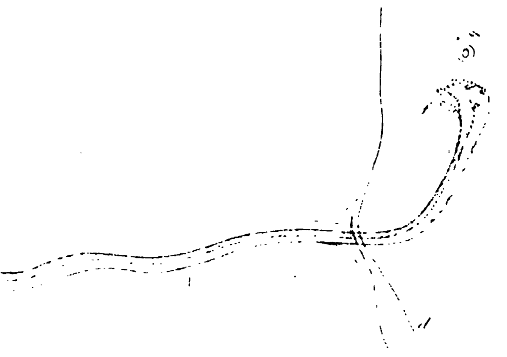
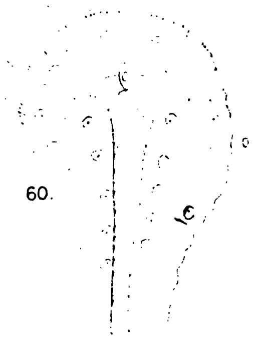
DELTANIA ELEGANS FIGS. 51 TO 58.





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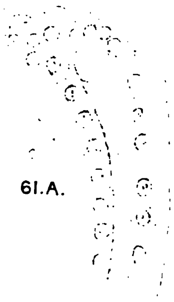
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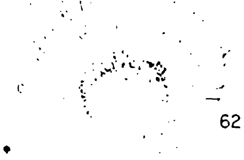
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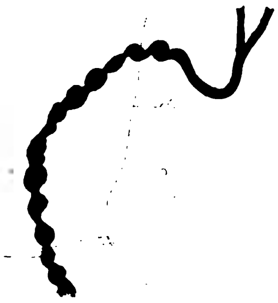
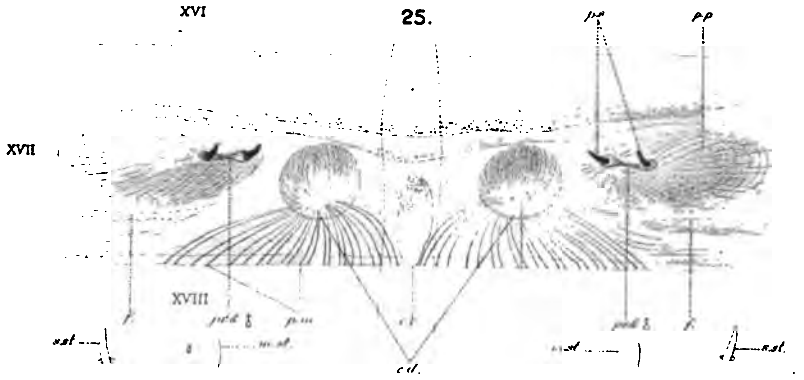
61.B.



GUSTAV EISEN DEL.

ARGILLOPHILUS MARMORATUS [illegible] ANATOMY [illegible]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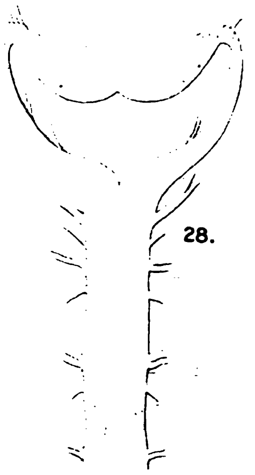
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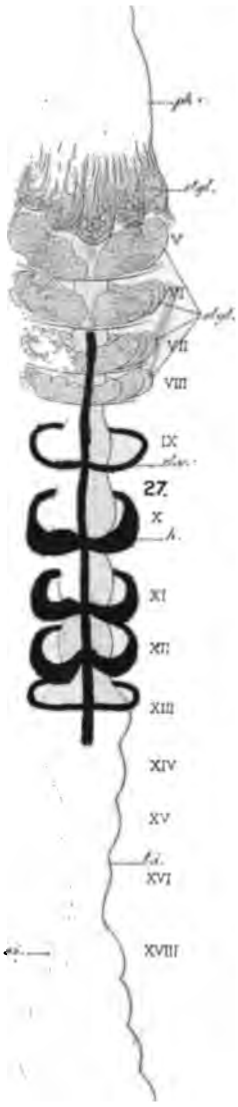
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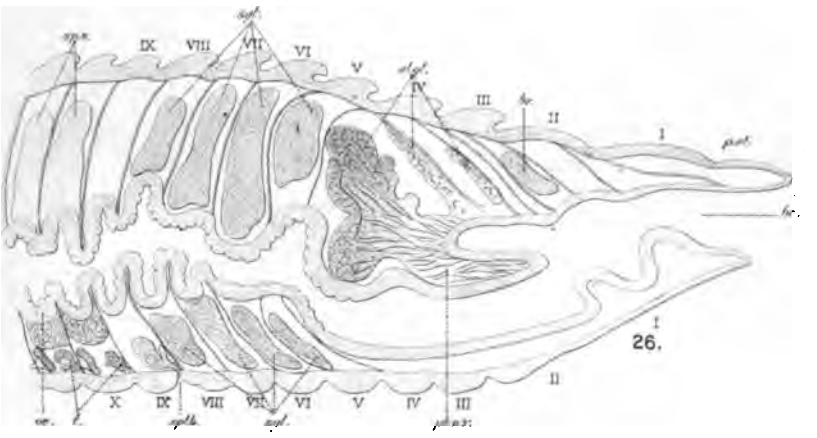
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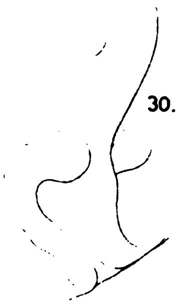
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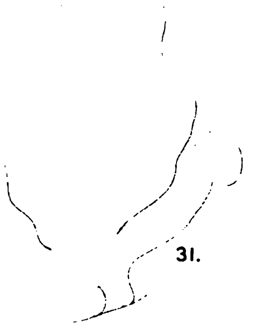
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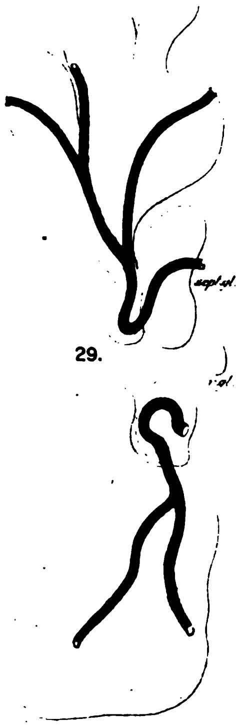
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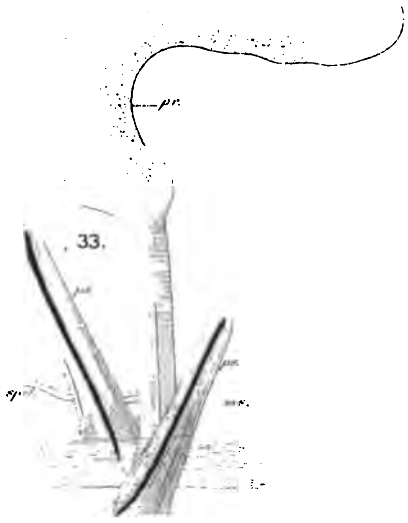
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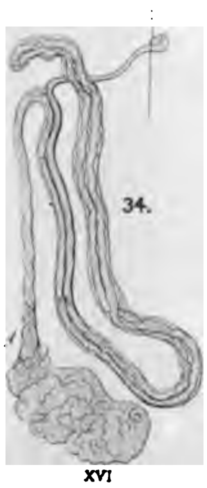
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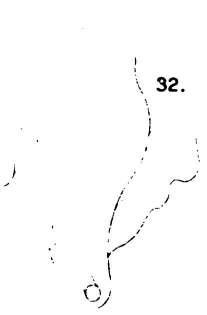
32.

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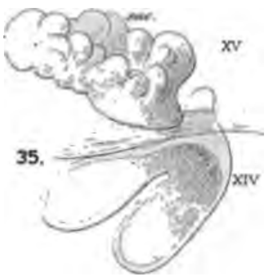
DELTANIA TROYERI FIG'S. 25 TO 34.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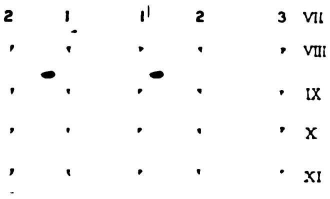
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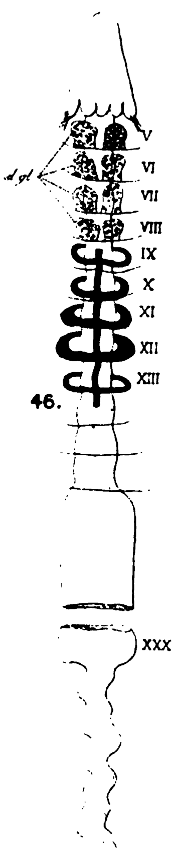
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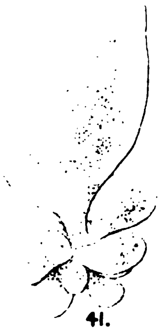
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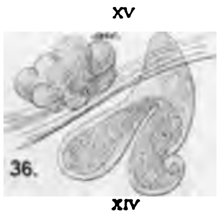
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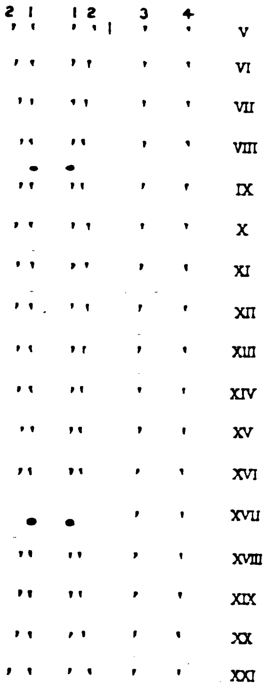
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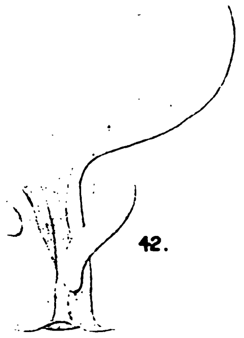
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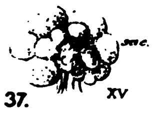
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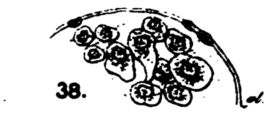
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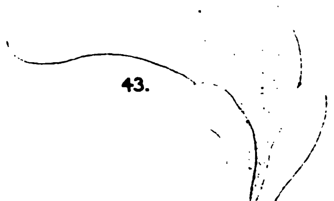
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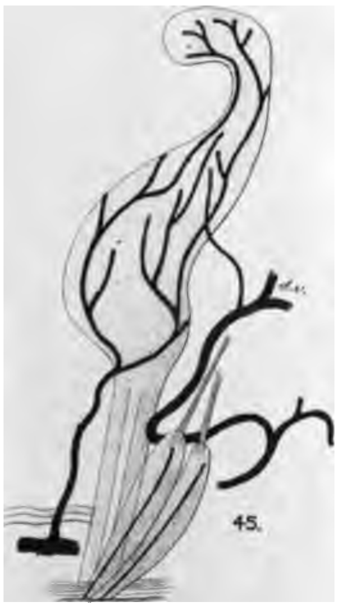
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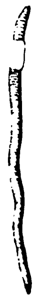
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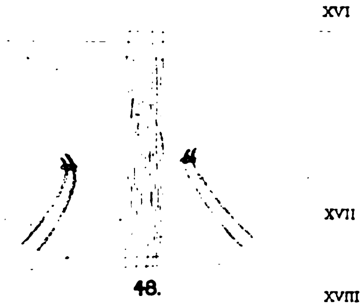
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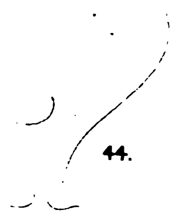
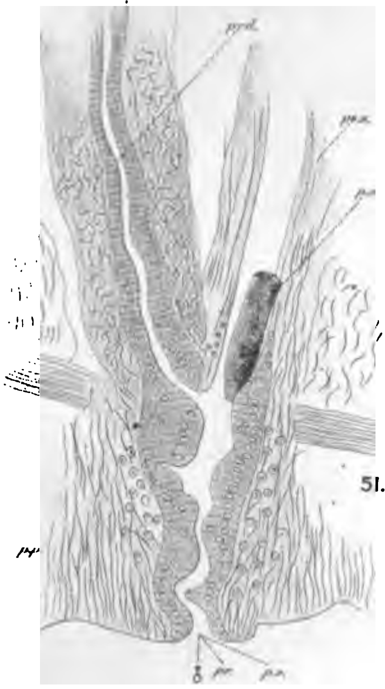

44.

GUSTAV EISEN, DEL.

LITH BRITTON & REY S.F.

DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S. 40 TO 48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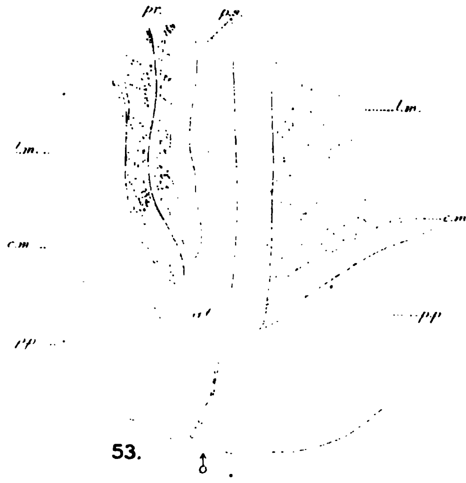
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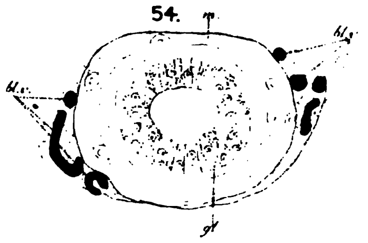
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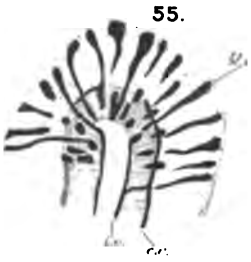
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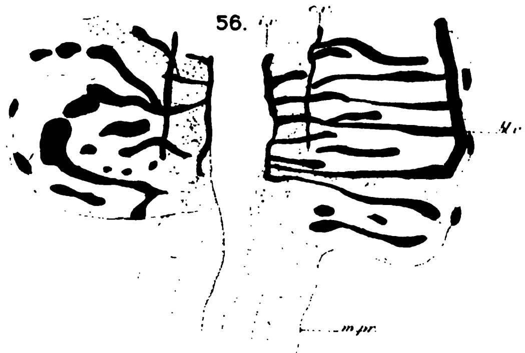
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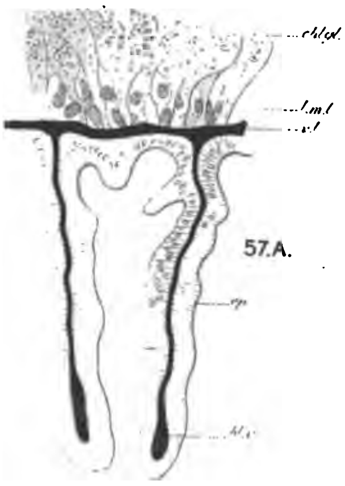
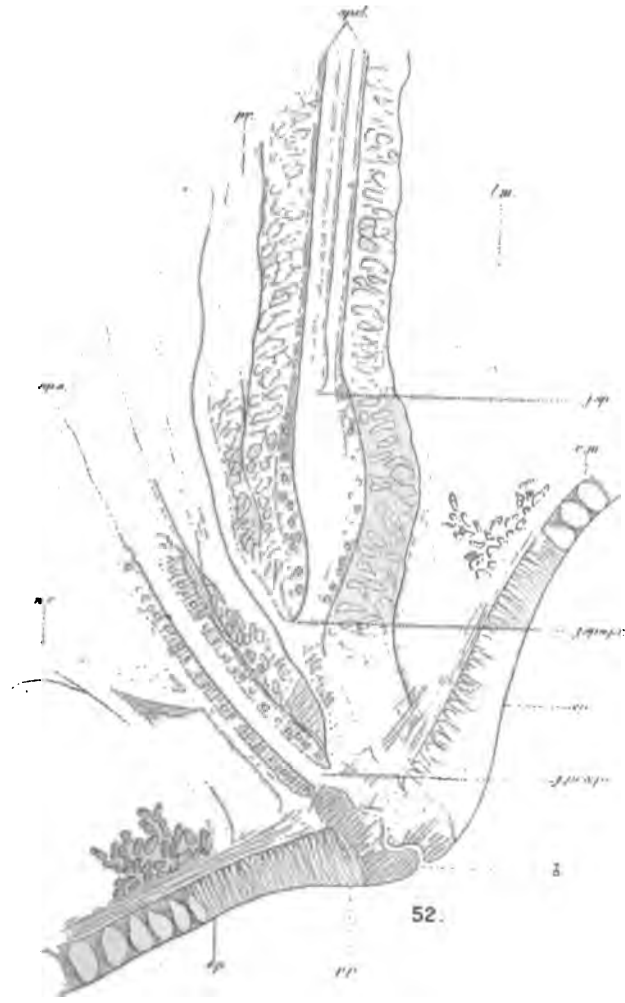

57.A.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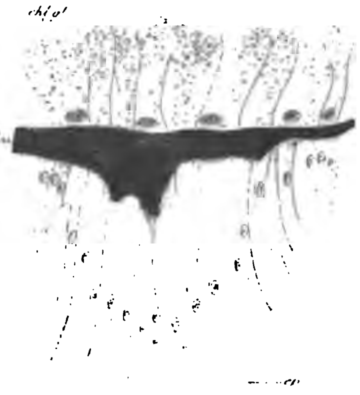
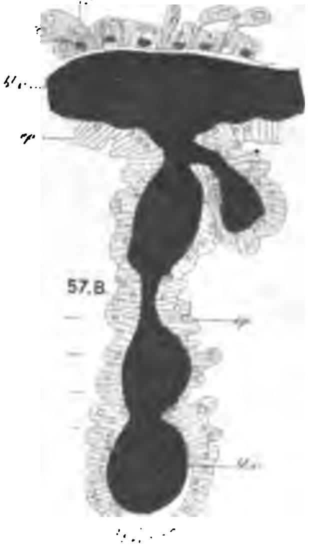
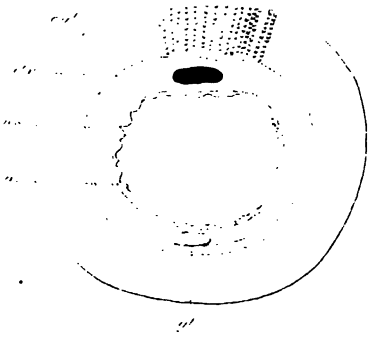

57.C.


57.B.


58.

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DELTANIA ELEGANS FIGS. 51 TO 58.

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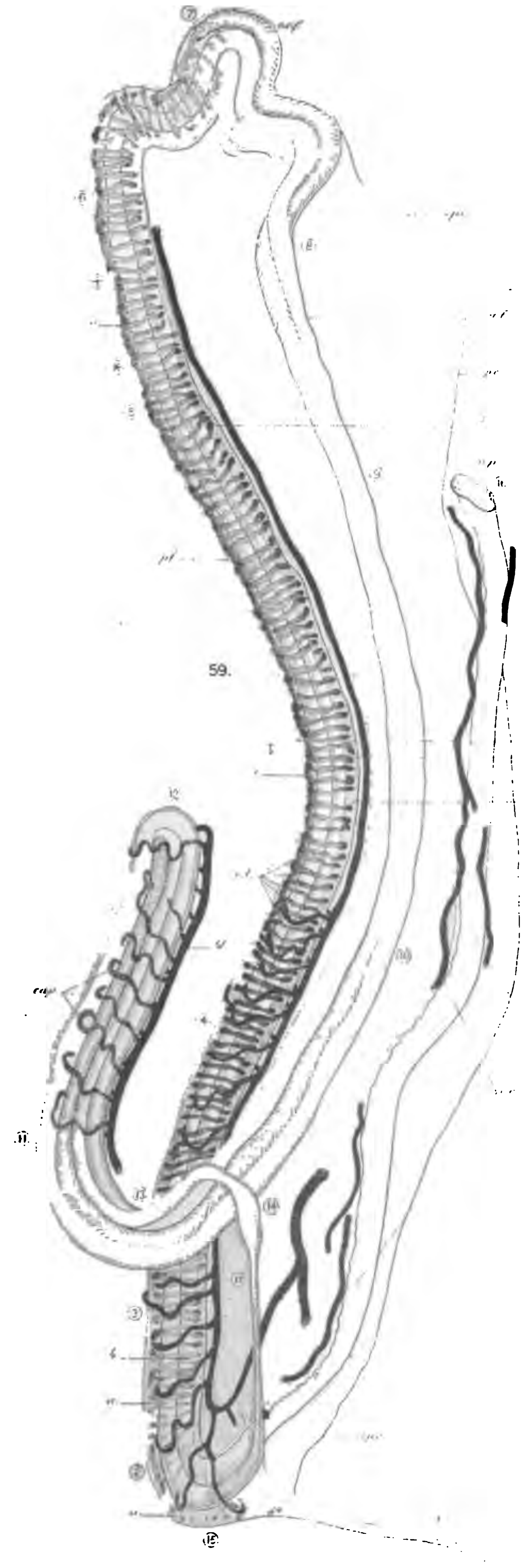

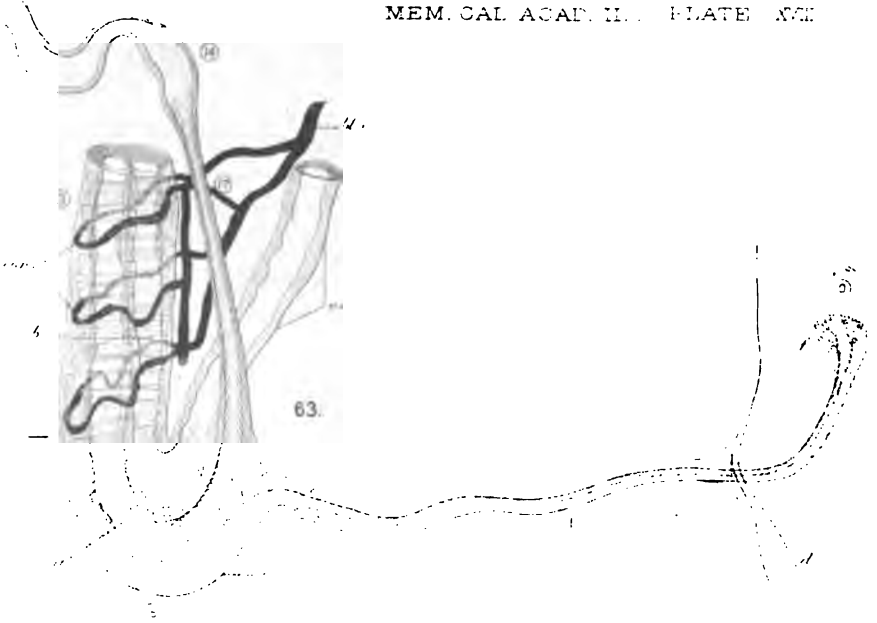

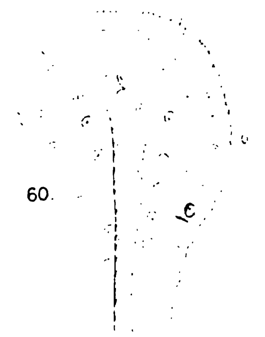
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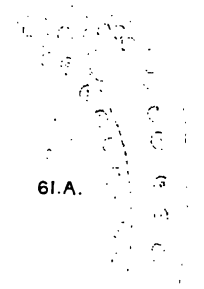
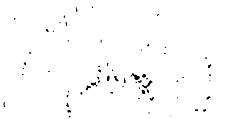

61.A.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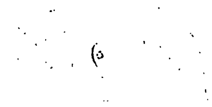
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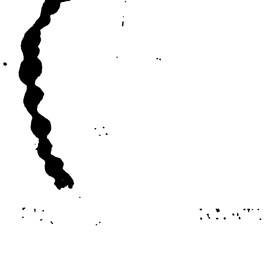

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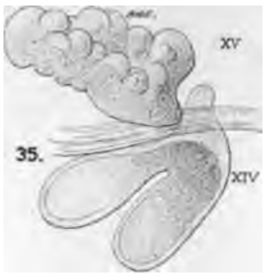
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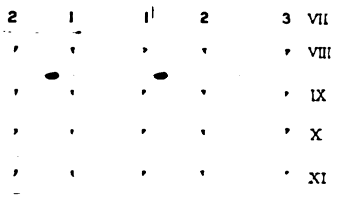
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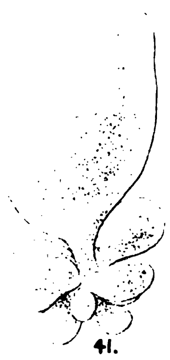
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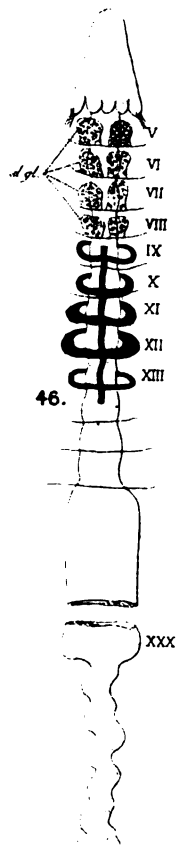
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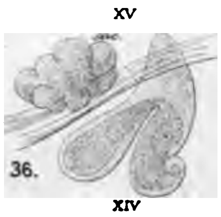
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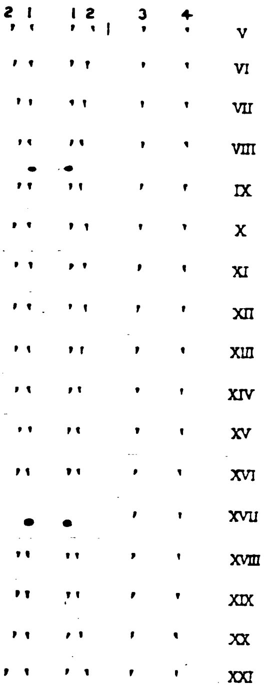
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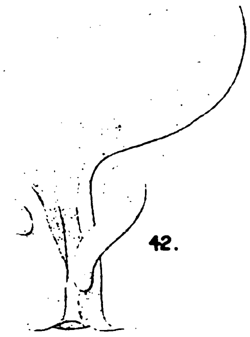
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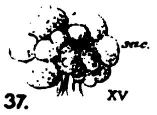
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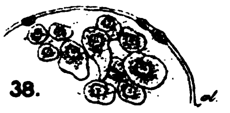
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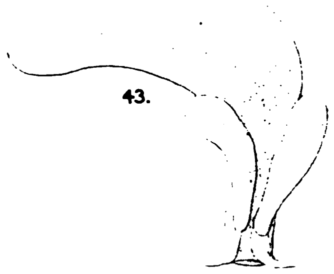
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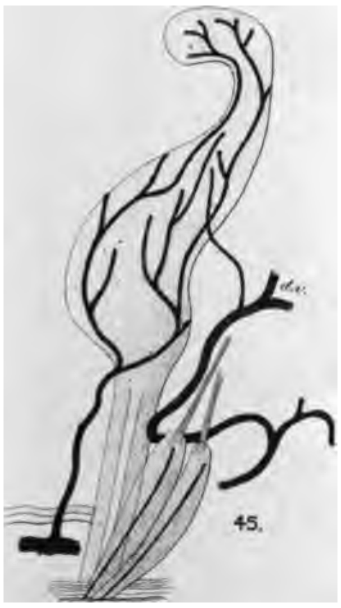
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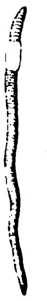
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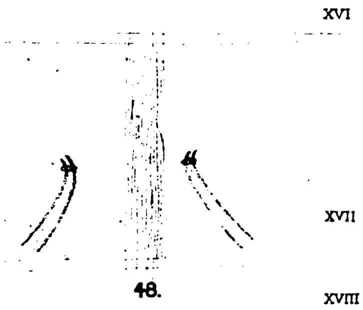
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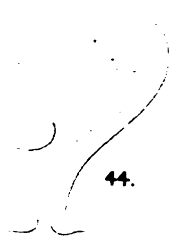
44.

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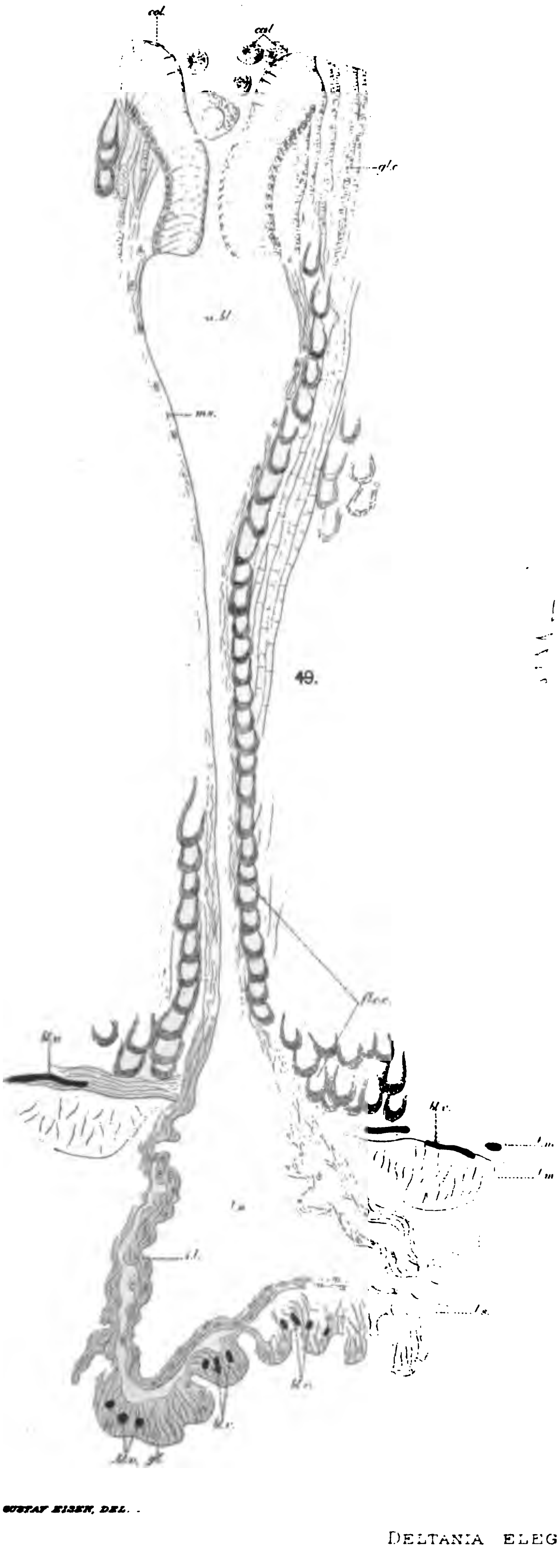
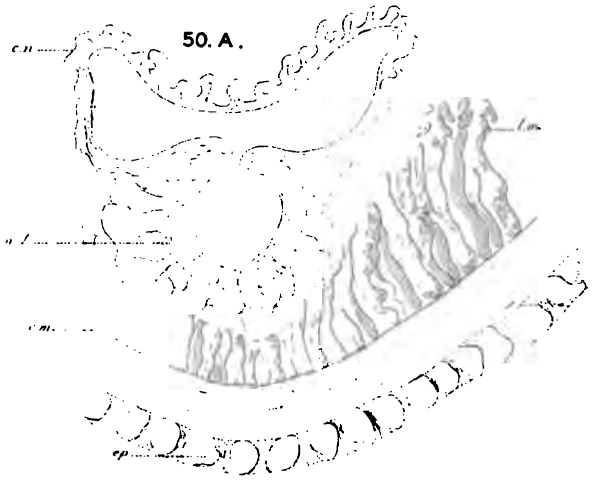
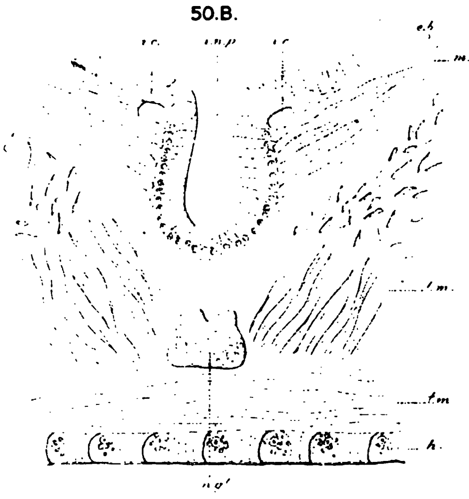
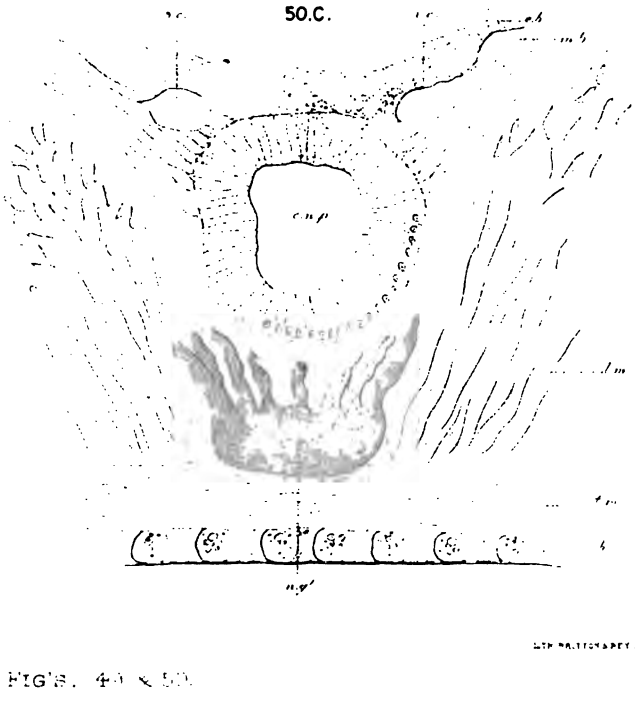
LITH. BRITTON & REY S.F.

DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S. 40 TO 48.





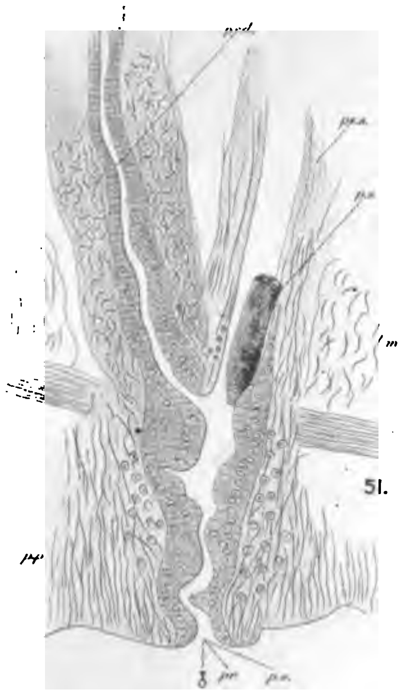




GUSTAV EISEN, DEL.

LITH. BRITTON & REY, S.F.

DELTANIA ELEGANS FIG'S. 49 & 50.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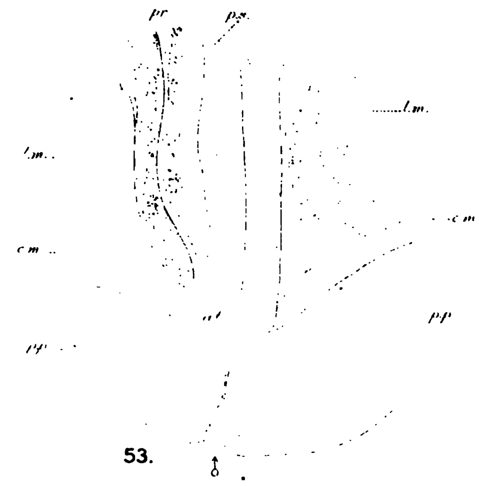
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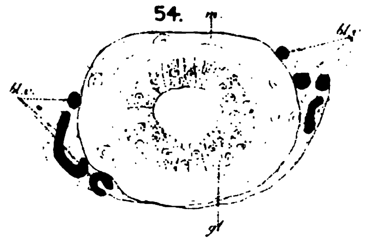
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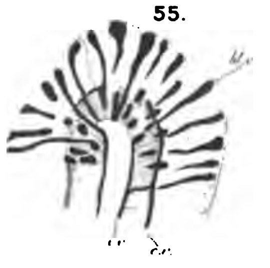
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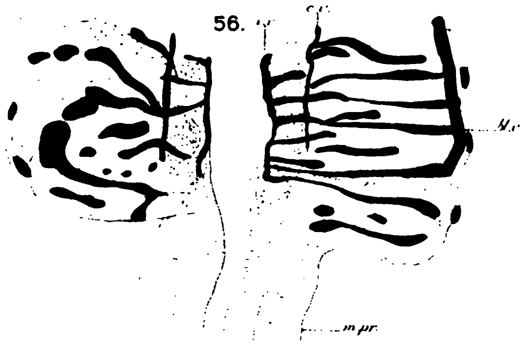
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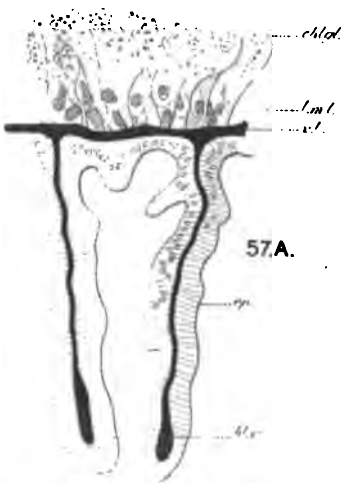
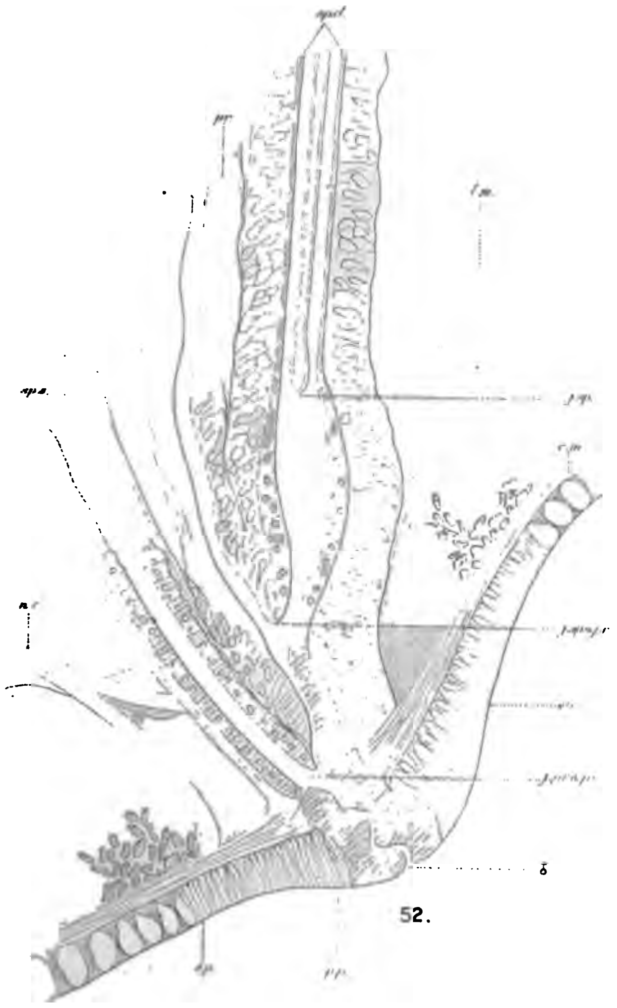

57.A.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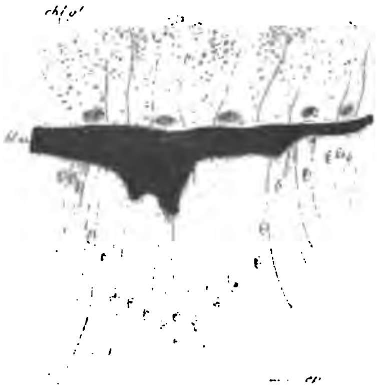
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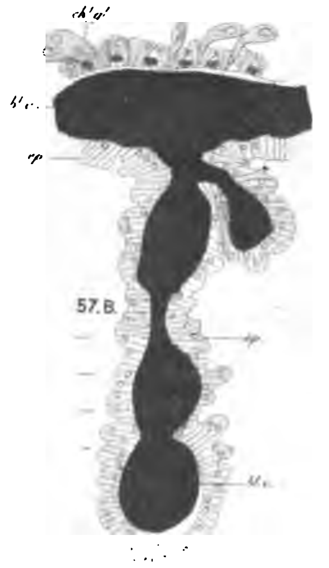
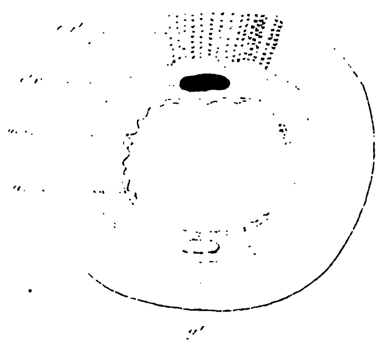

57.B.


58.

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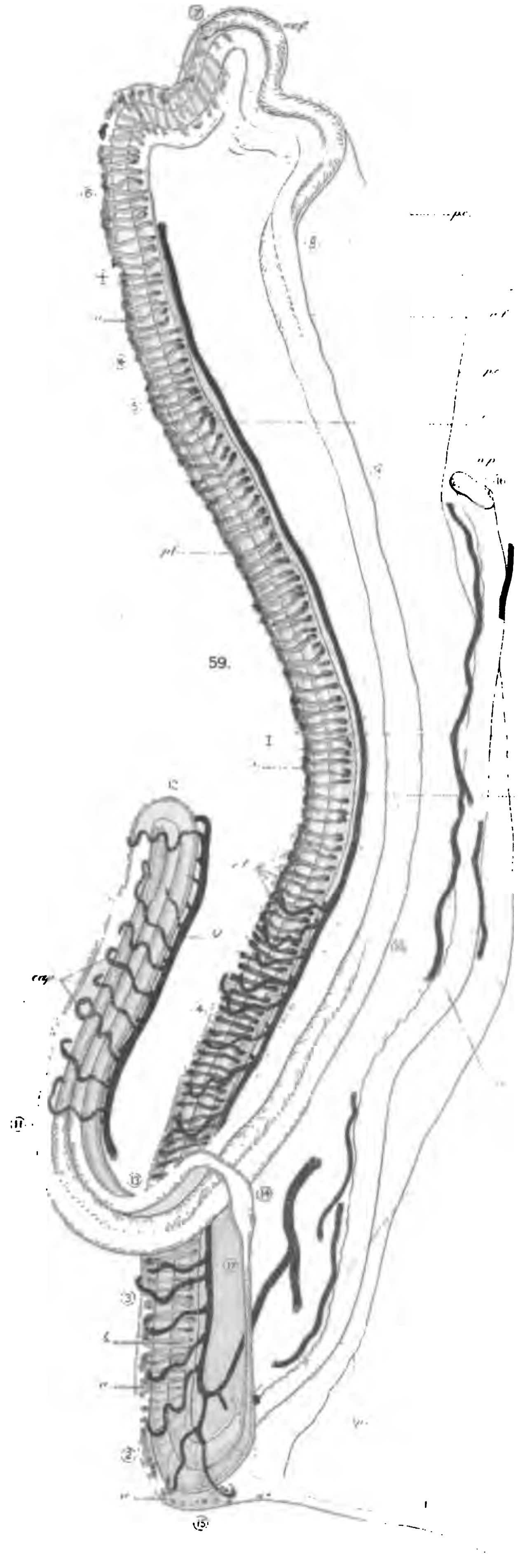
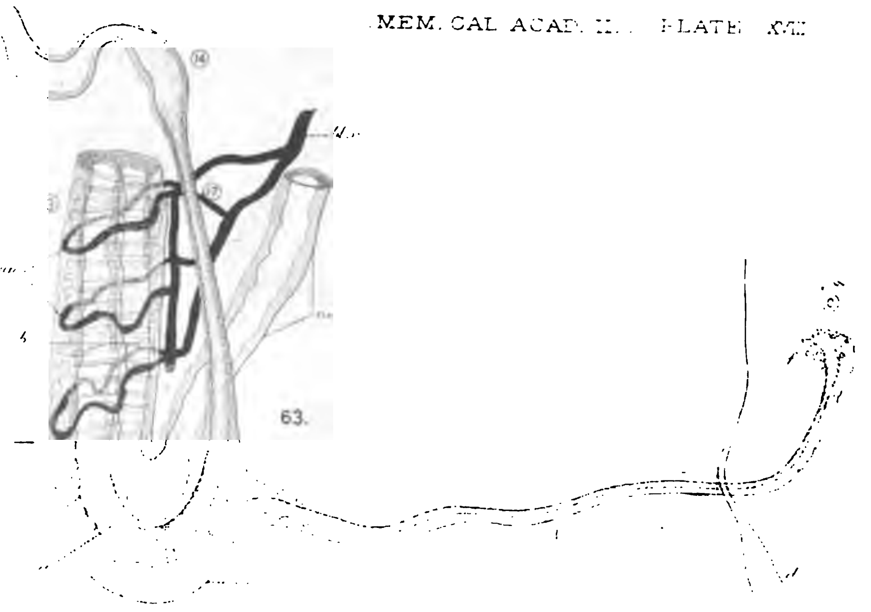
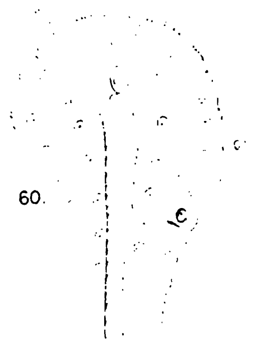
DELTANIA ELEGANS FIGS. 51 TO 58.



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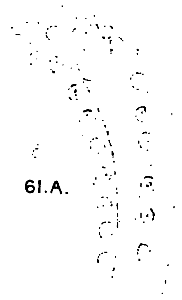
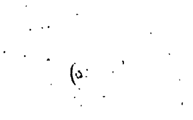
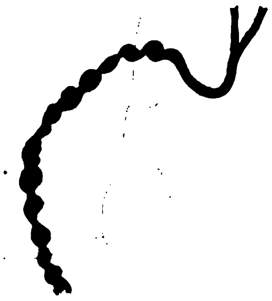

61.A.

62.


61.B.



GUSTAV EISEN DEL.

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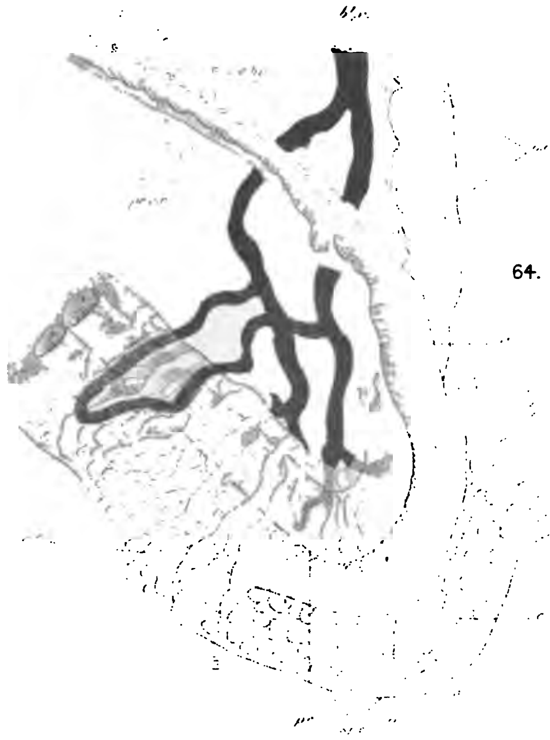

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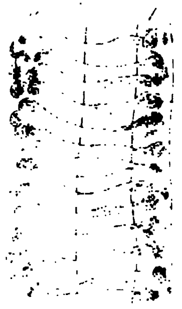

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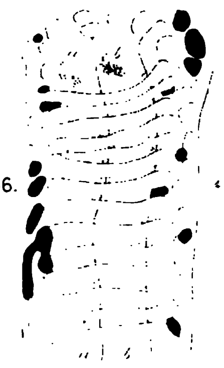

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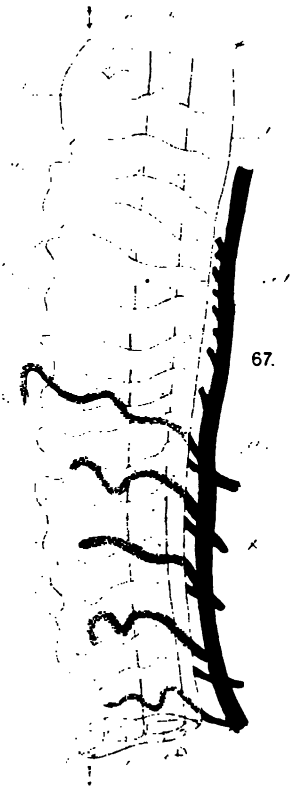

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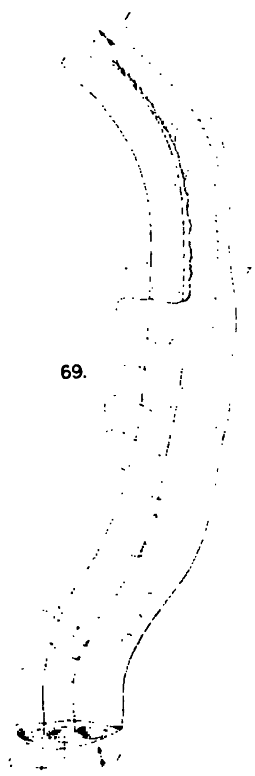

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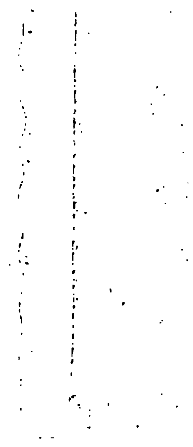

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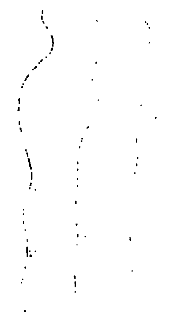

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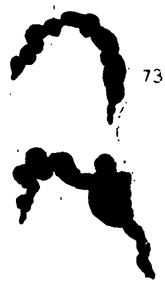
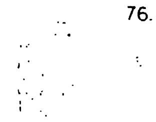


73.

74 A.

74 B.

75.



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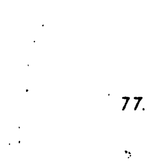
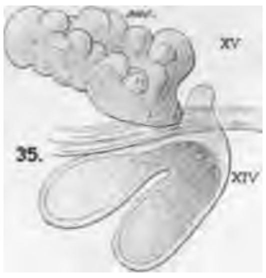


77.

GUSTAV EISEN, DEL.



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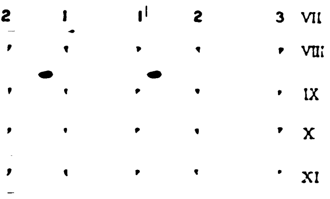

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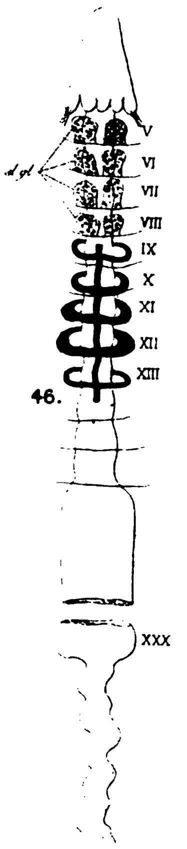

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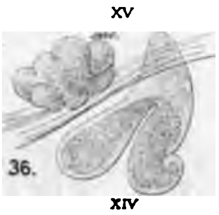
41.



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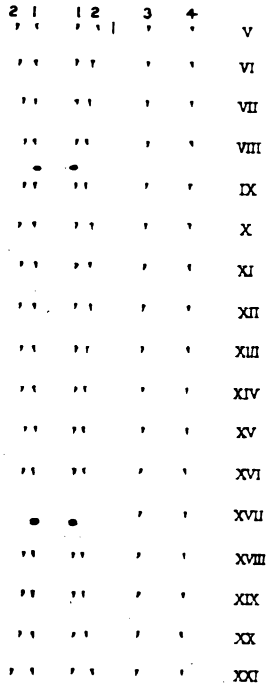

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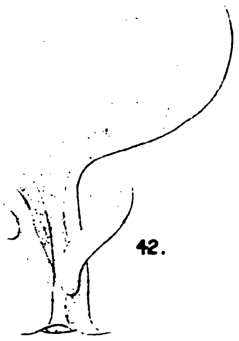

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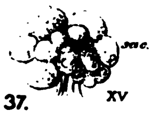

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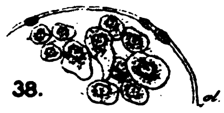

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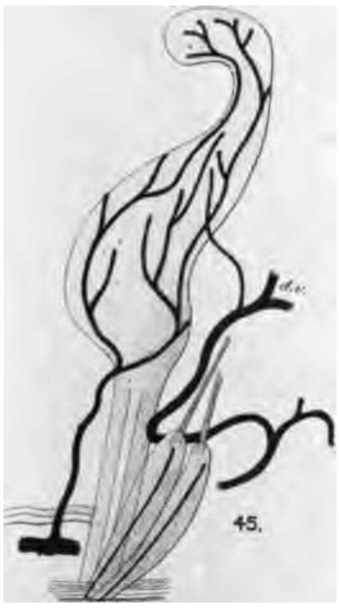

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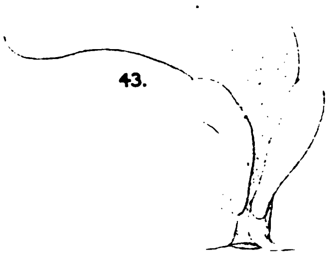

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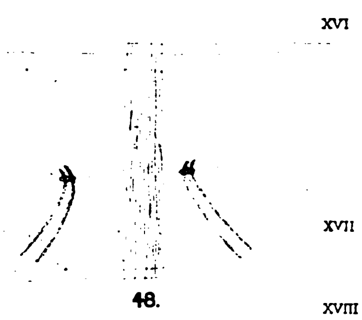

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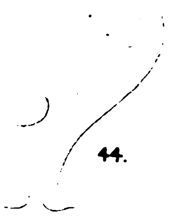
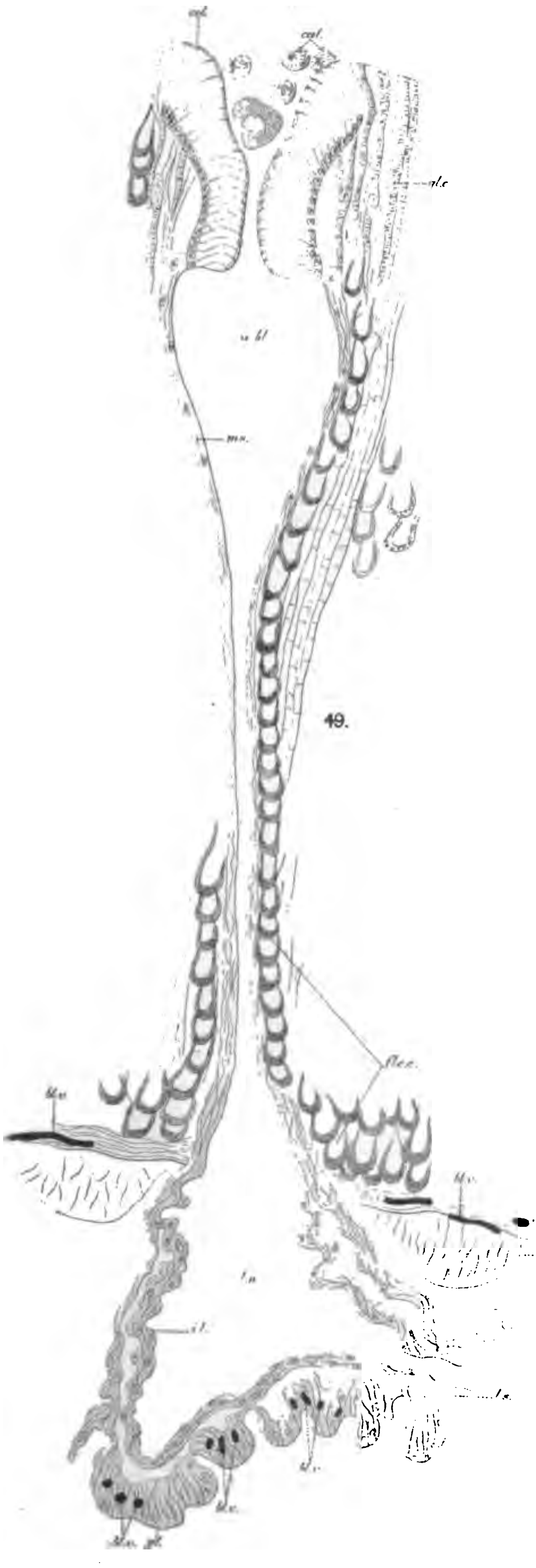


44.

GUSTAV EISEN, DEL.

DELTANIA TROYERI FIG'S. 35 TO 39. DELTANIA BENHAMI FIG'S 40 TO 48



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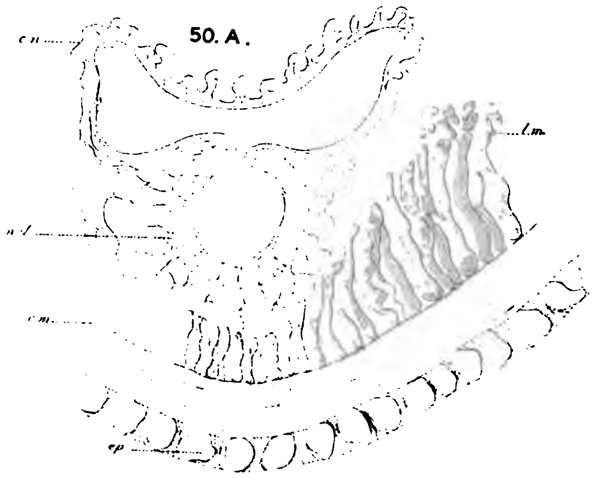
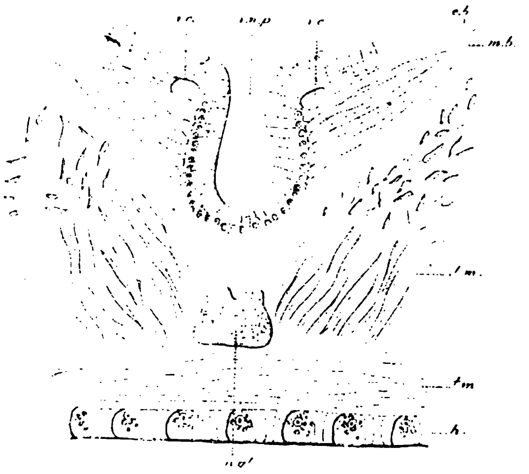
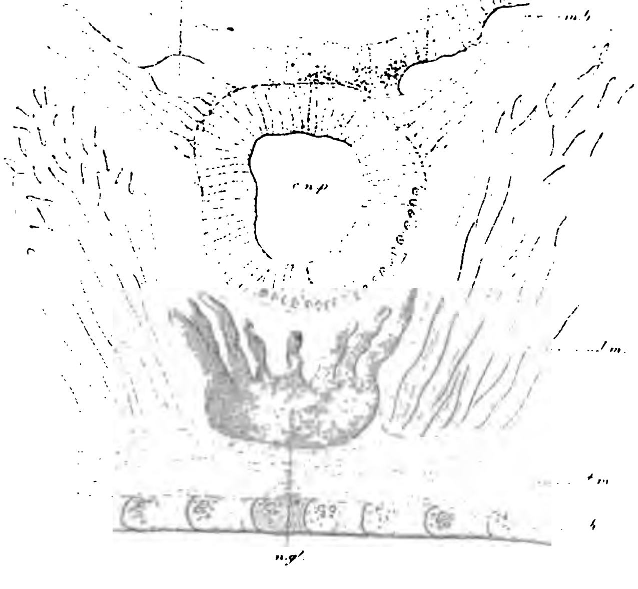
50. A.



50.B.



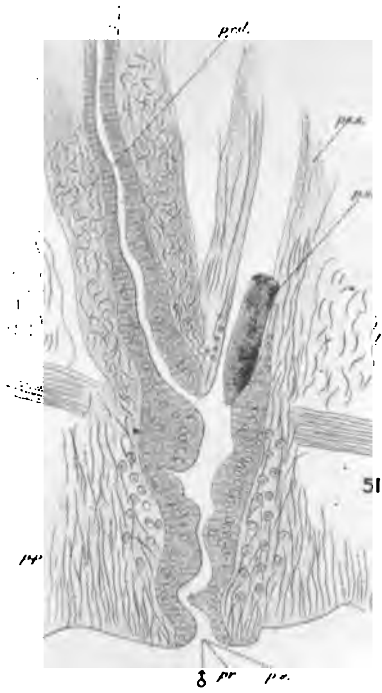
50.C.



GUSTAV EISEN, DEL.

DELTANIA ELEGANS FIG'S. 49 & 50

LITH. BRITTON & REY S.F.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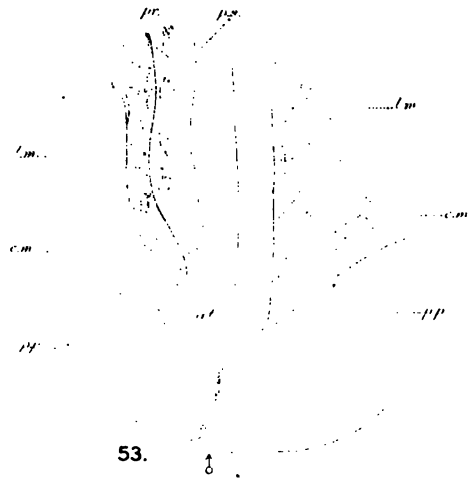
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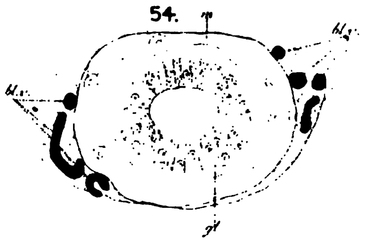
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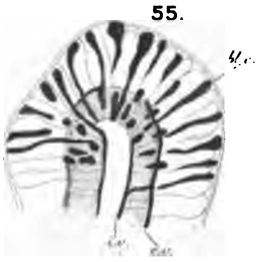
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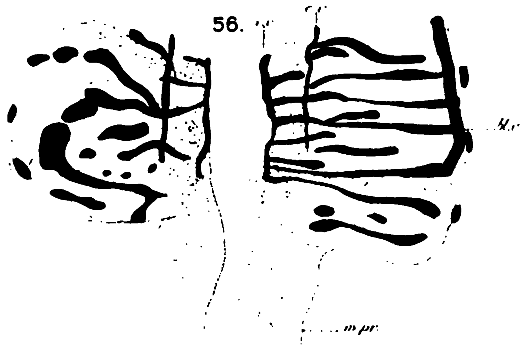
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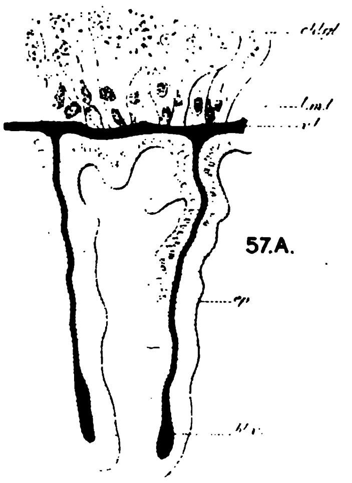
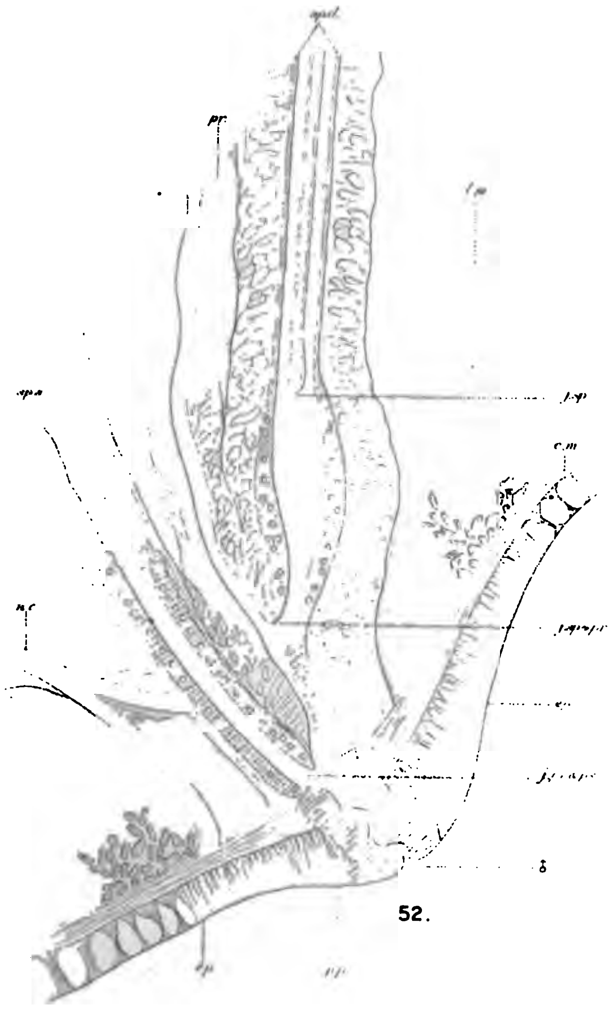

57.A.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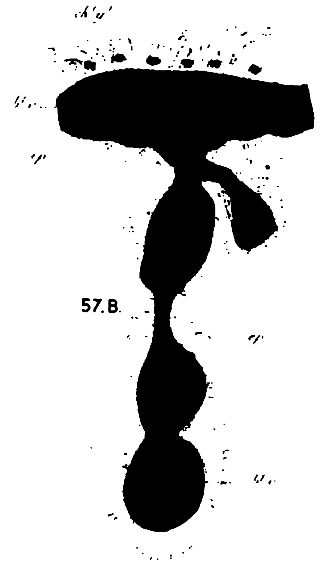
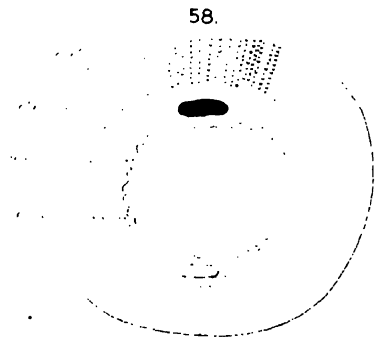
57.C.


57.B.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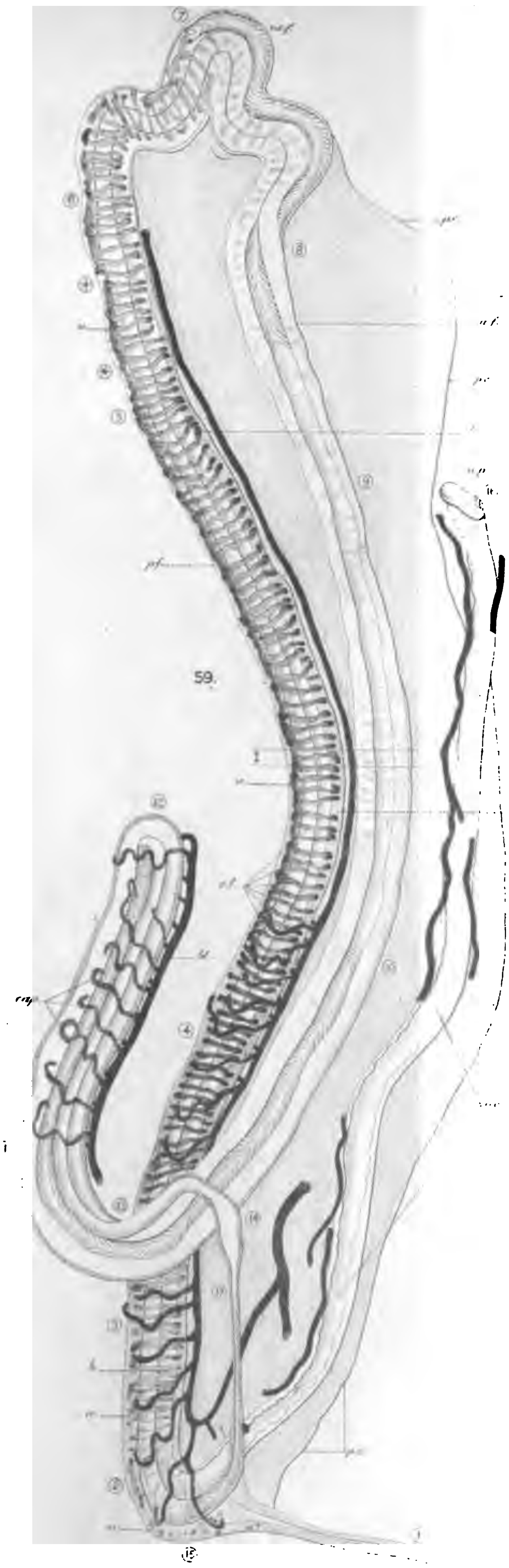
GUSTAV EISEN DEL.

DELTANIA ELEGANS EISEN.



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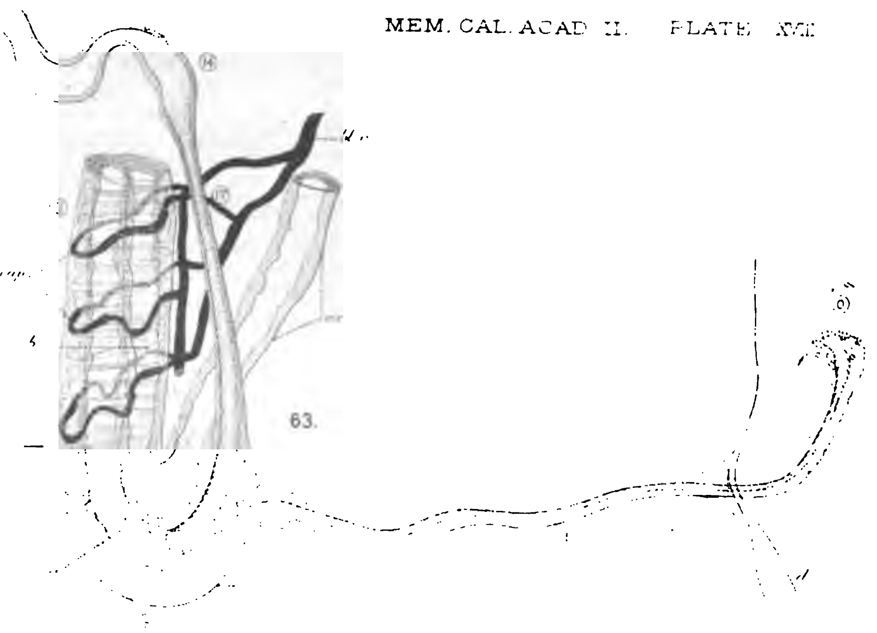

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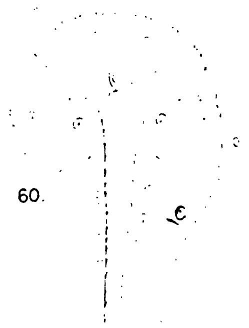

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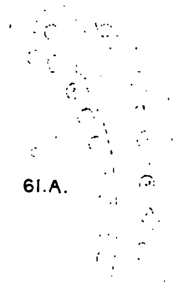
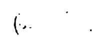


61.A.

62.



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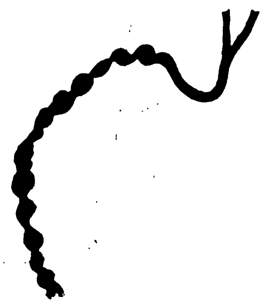

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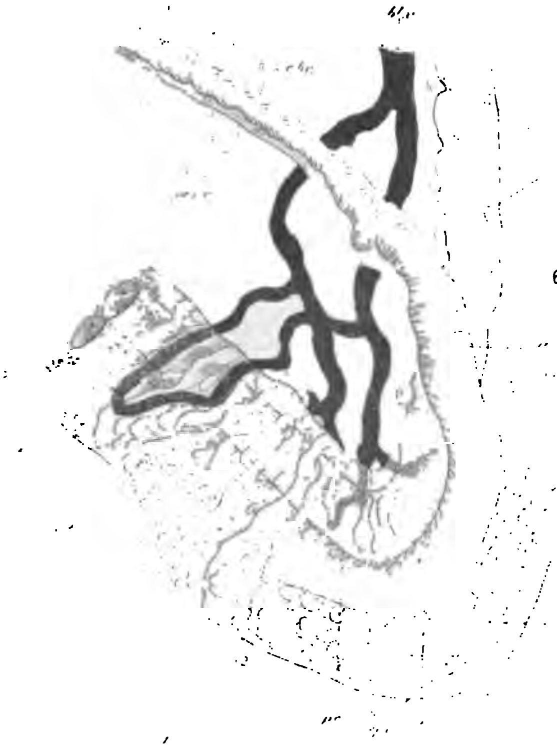

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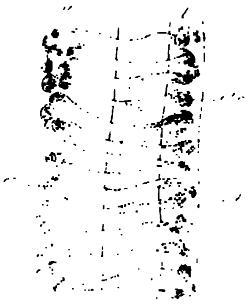

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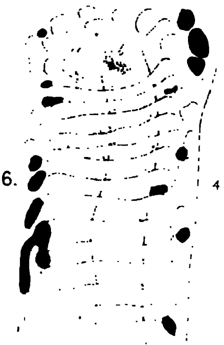

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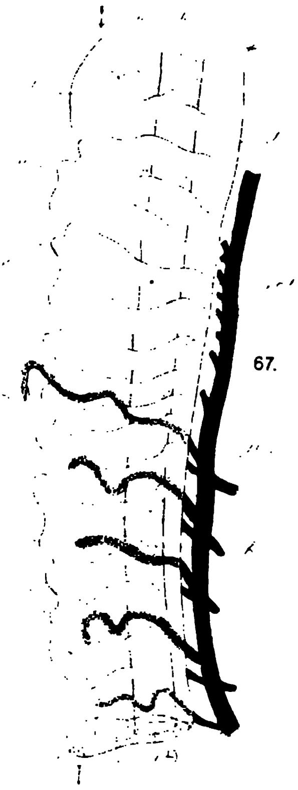

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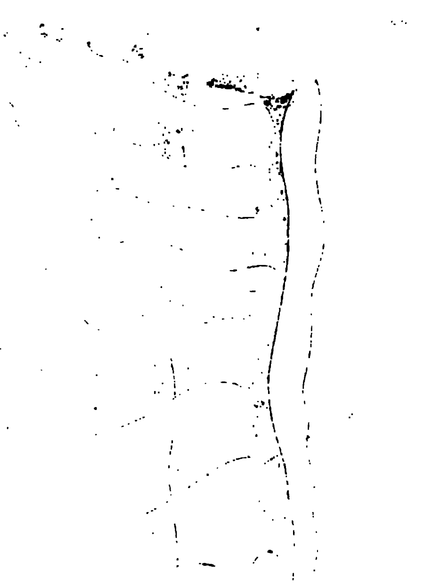

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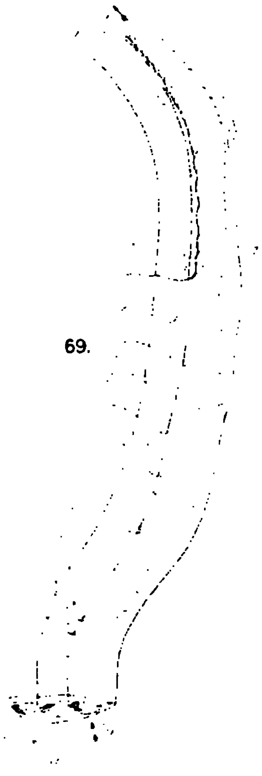

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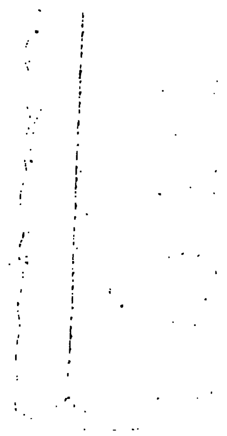

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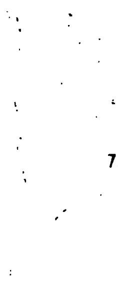
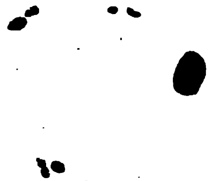
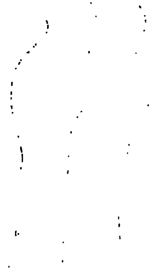


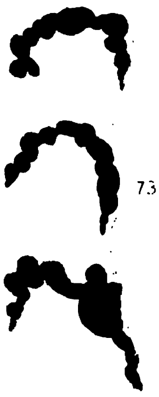


74A.

76.

72.





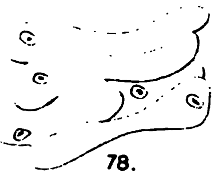
73.

74B.

70.

77.

GUSTAV EISEN DEL.



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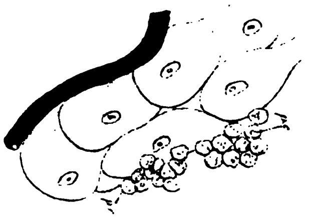
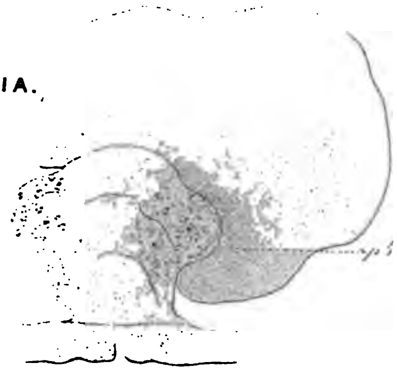


79.

80.

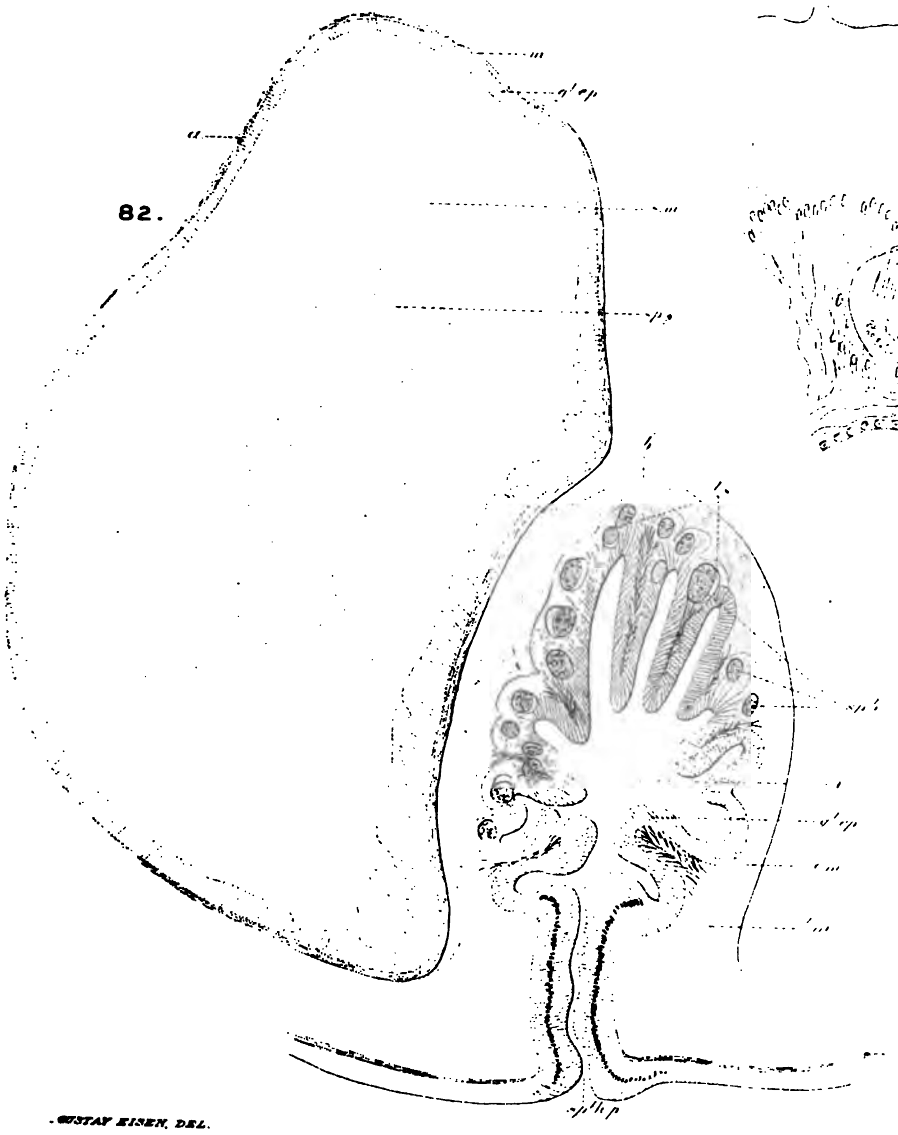
81 A.



81 B.

81 C.

82.



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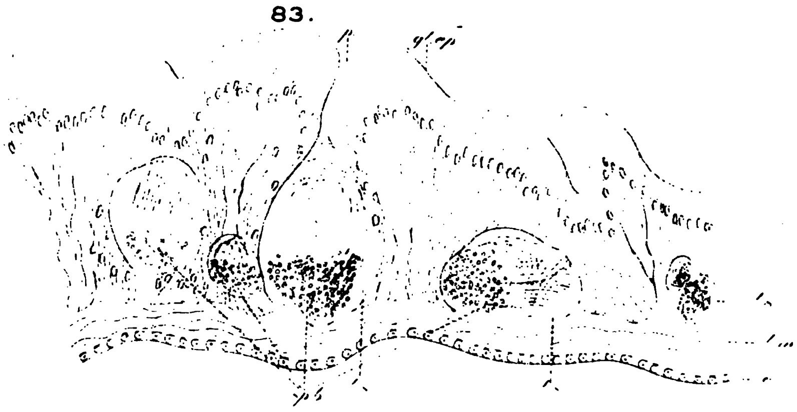

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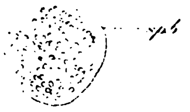

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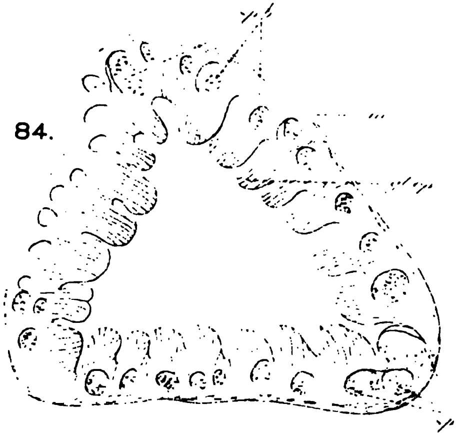

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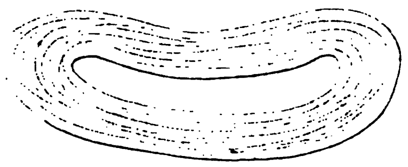
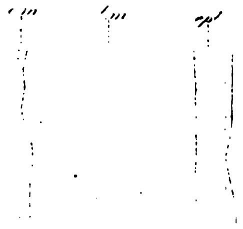
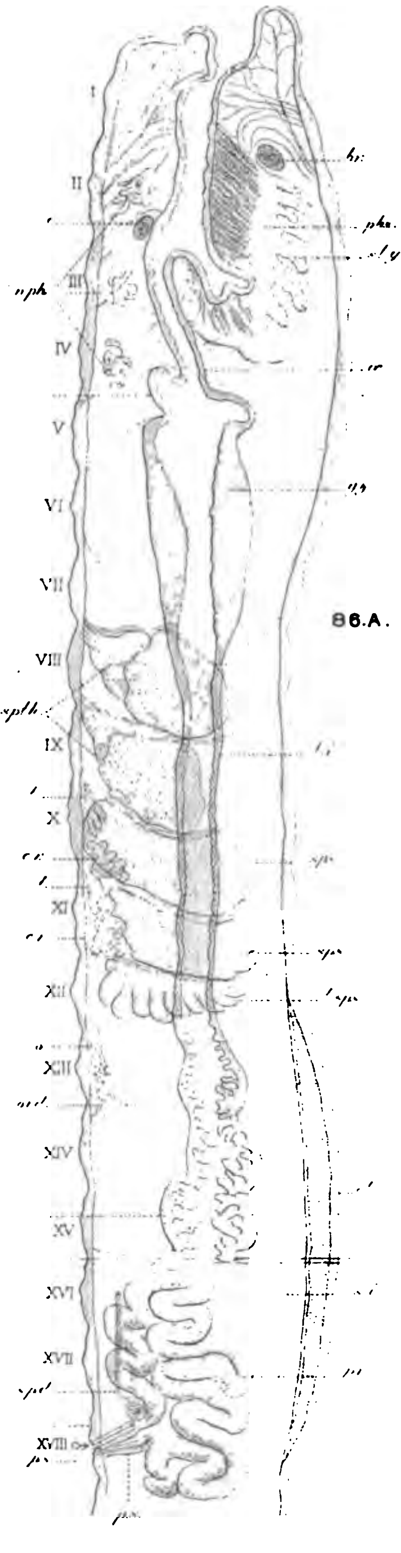
ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 78 TO 85.

87. B.



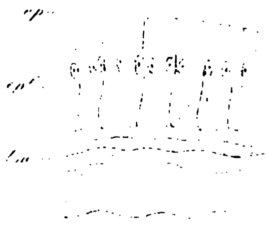


87. A.



86. A.

88.



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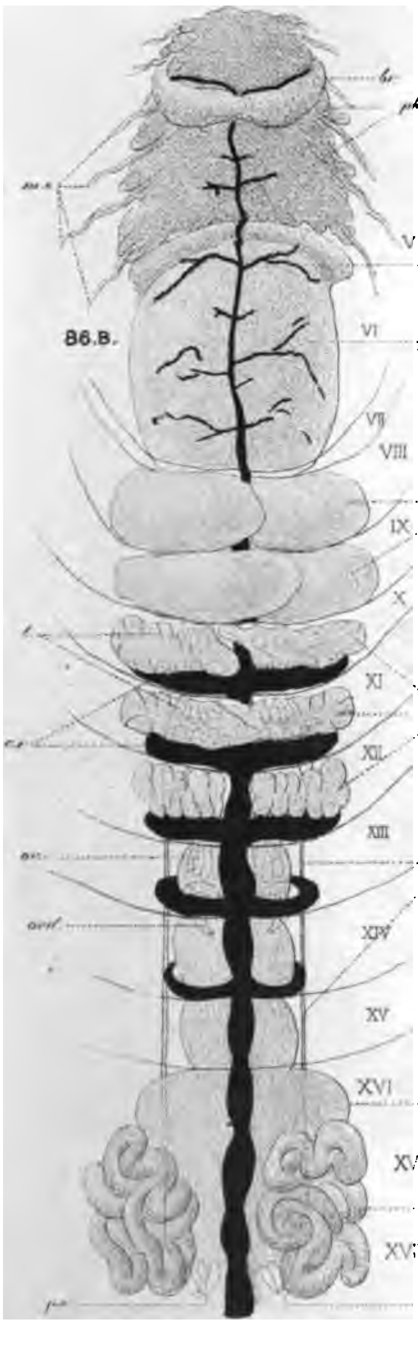

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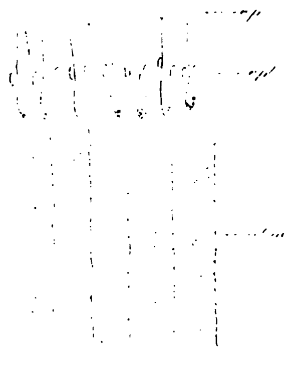
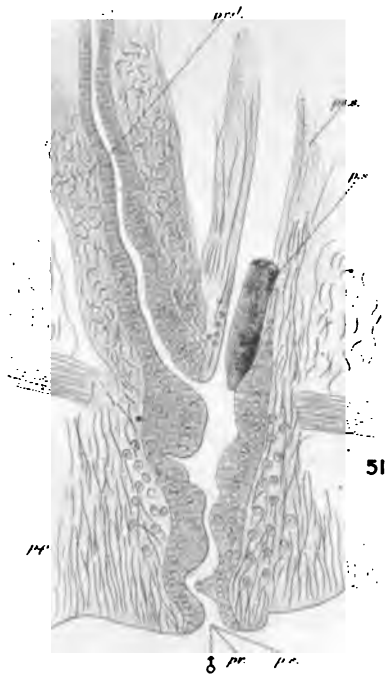


GUSTAV EISEN, DEL.

ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 86 TO 89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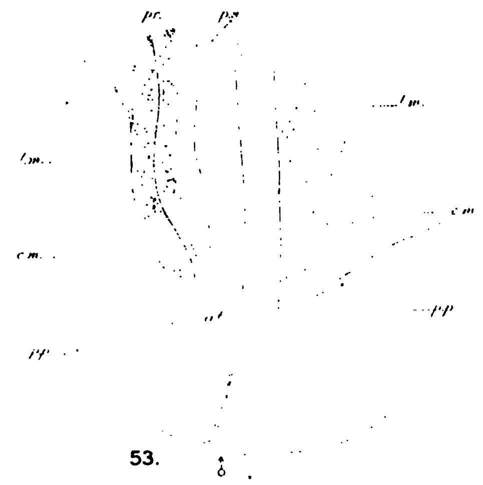
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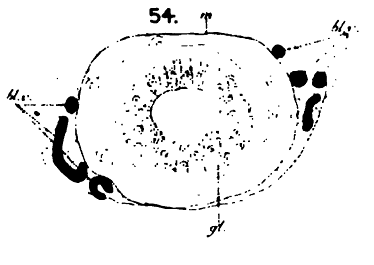
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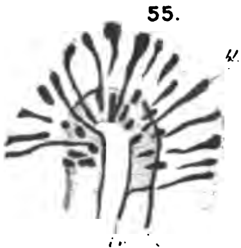
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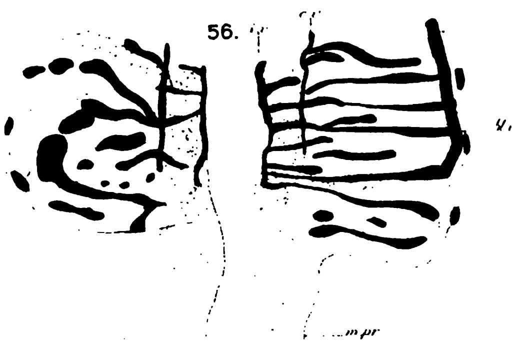
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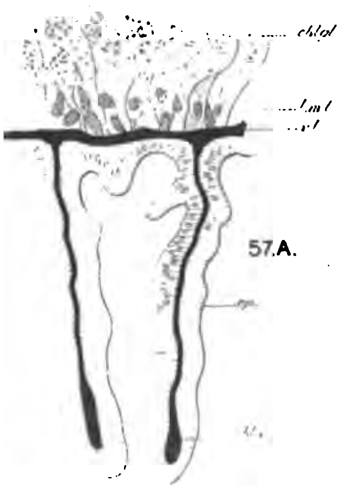
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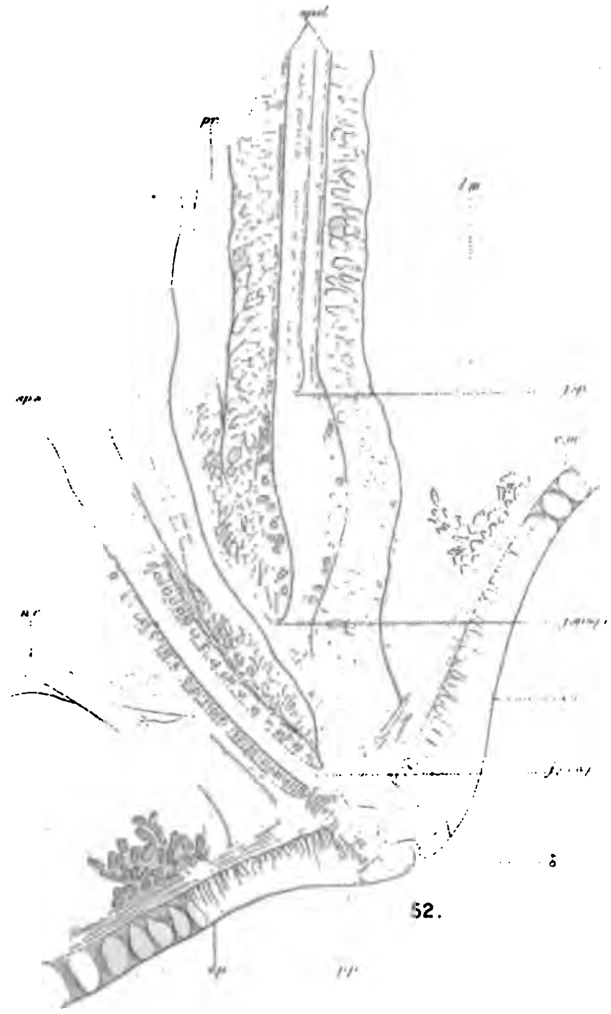
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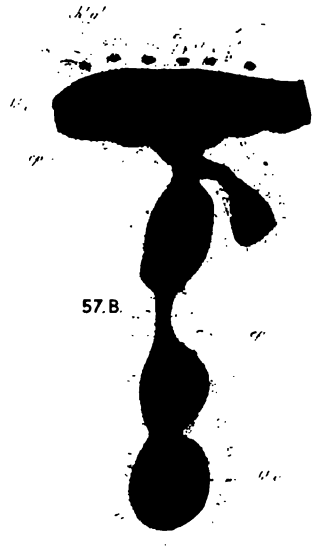
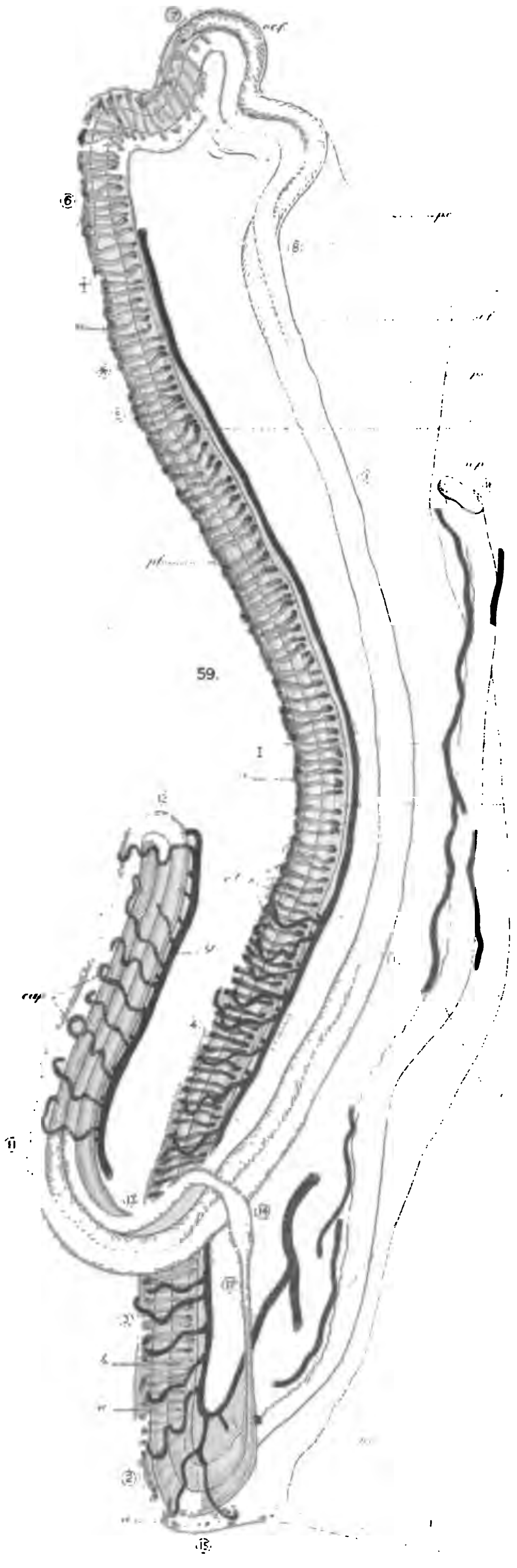
57.C.

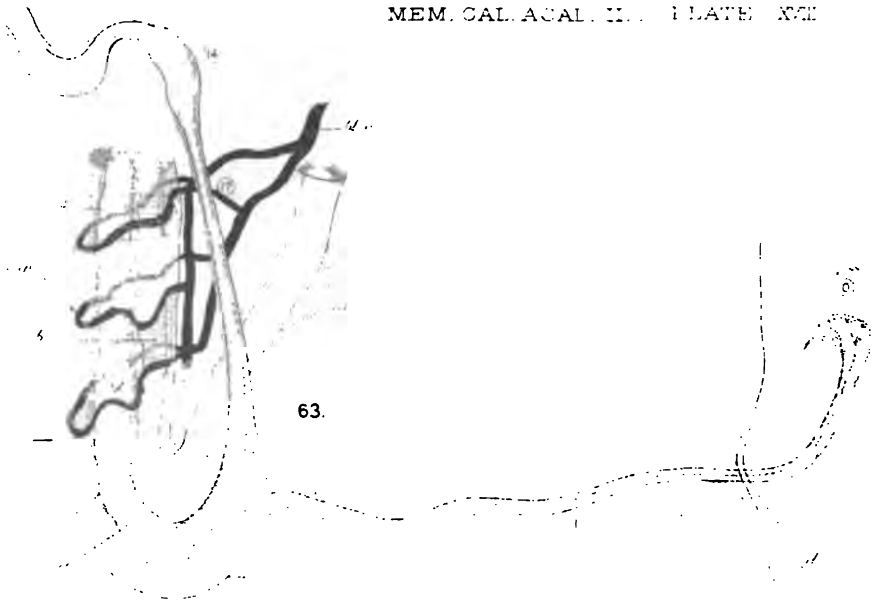
58.

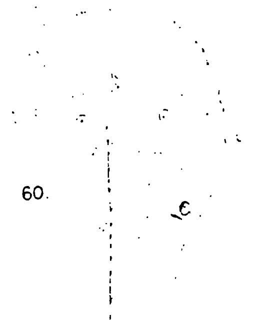

57.B.

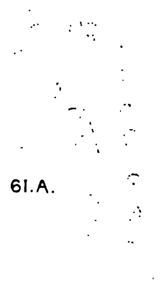
GUSTAV EISEN DEL.

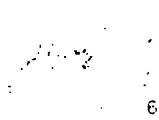
DELTANIA ELEGANS EISEN.



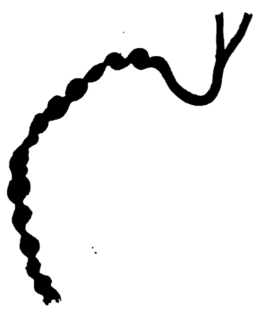








61.B.



GUSTAV EISEN DEL.

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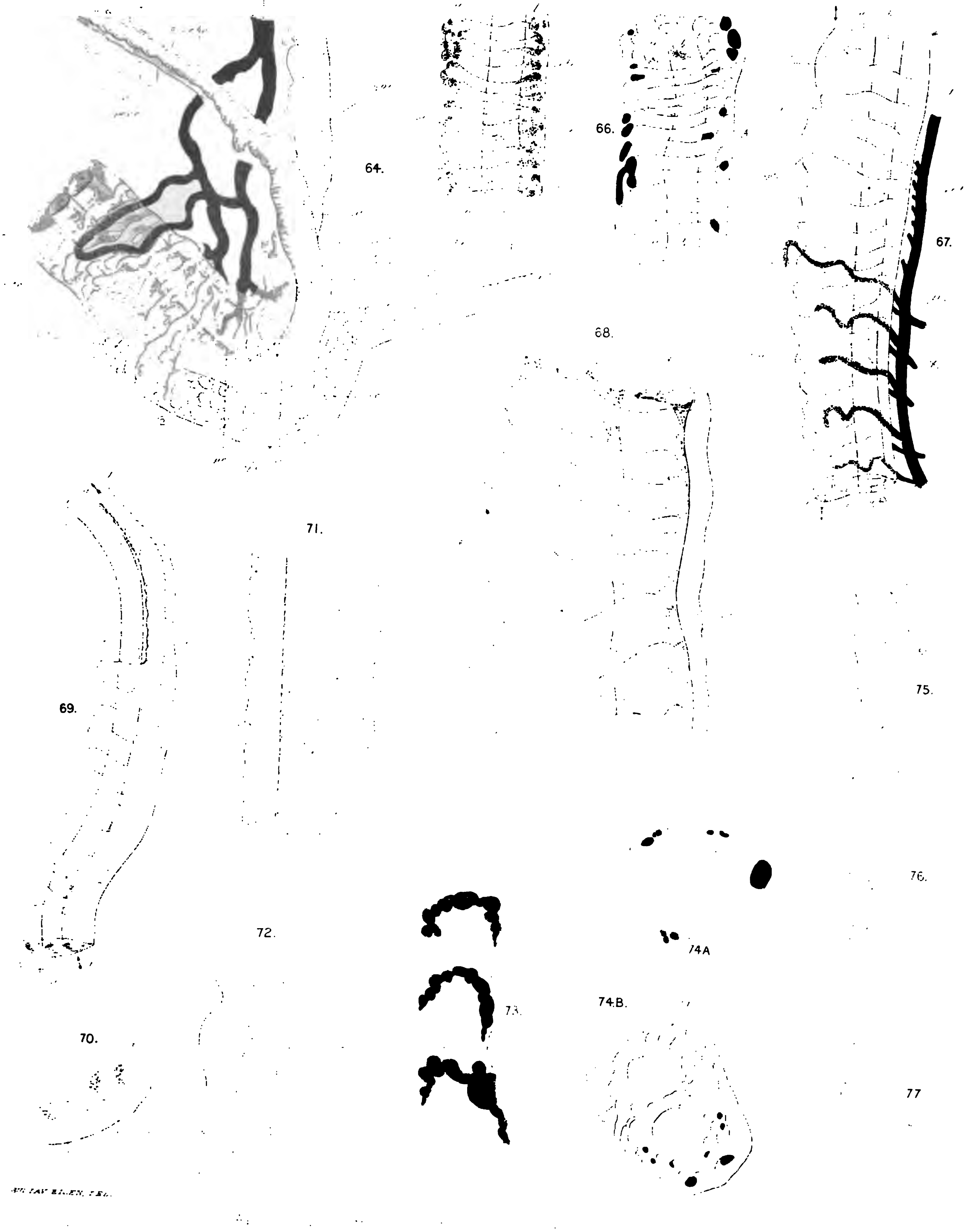
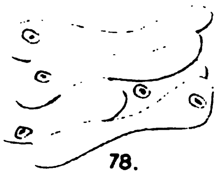


GUSTAV EISEN, FEC.



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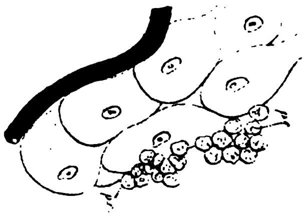

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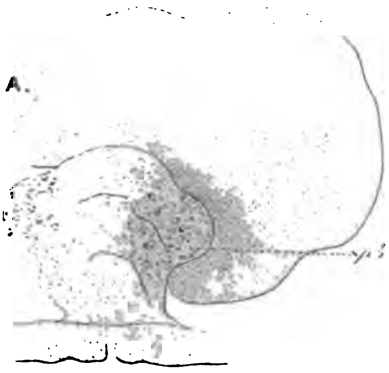
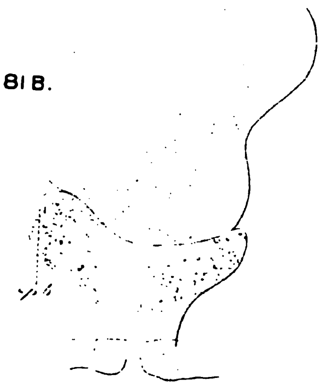
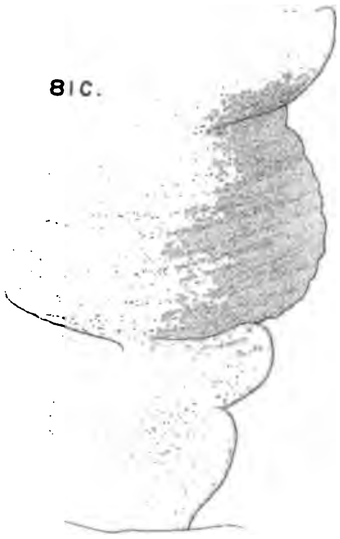


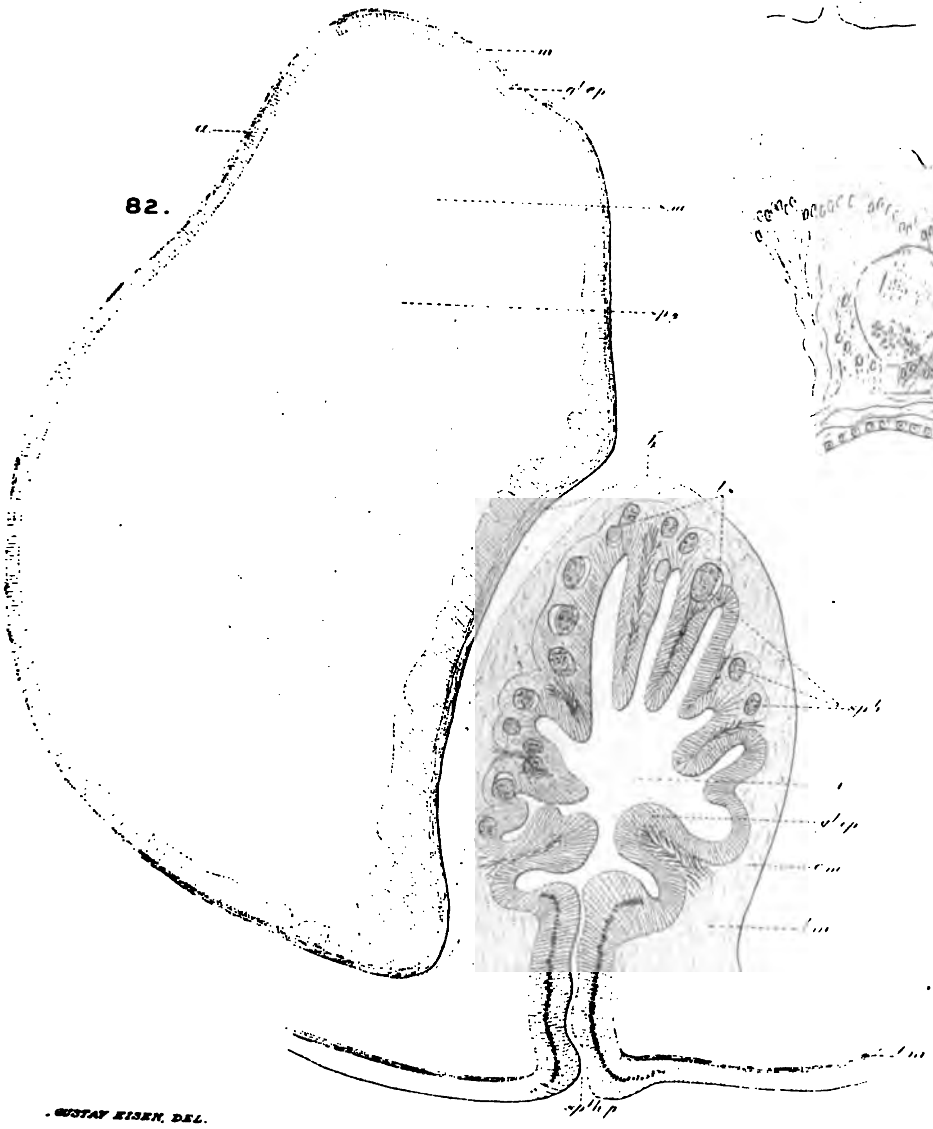
81 A.



81 B.



81 C.



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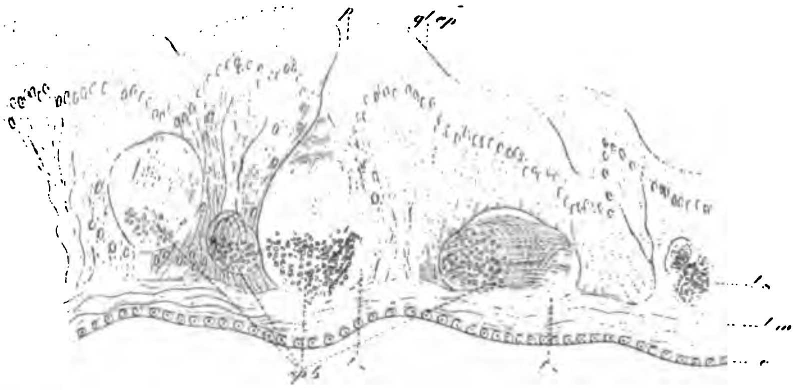
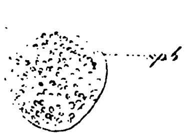


83.



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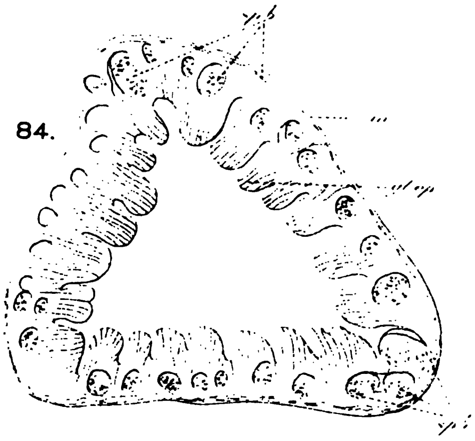

84.

GUSTAV EISEN, DEL.

ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 78 TO 85.

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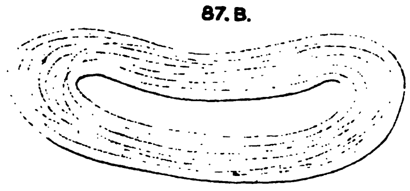
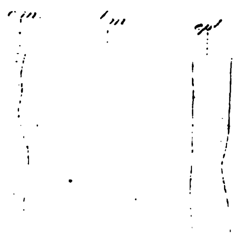
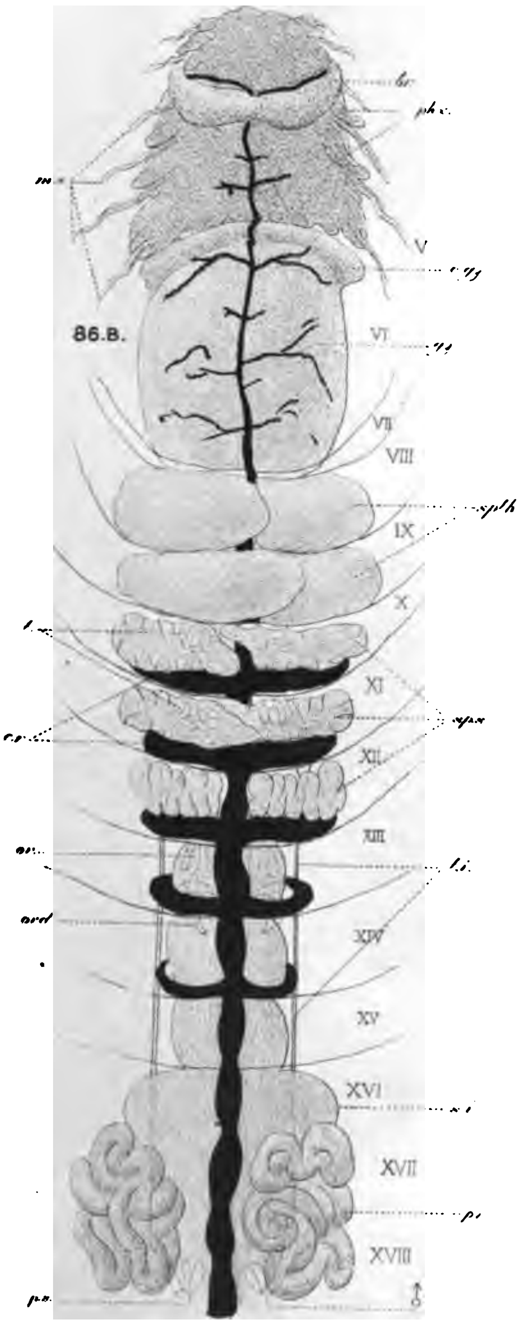
87.B.



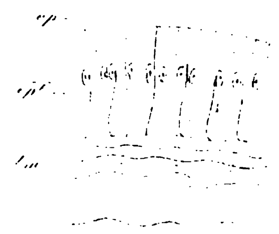


87.A.

86.B.



88.



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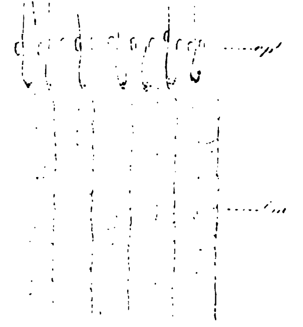
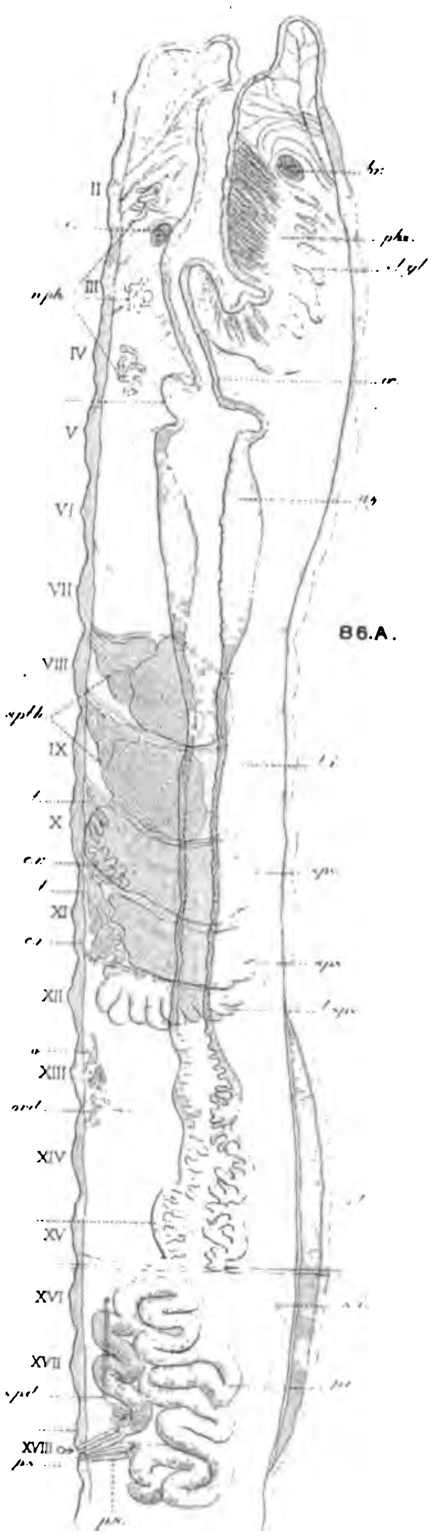
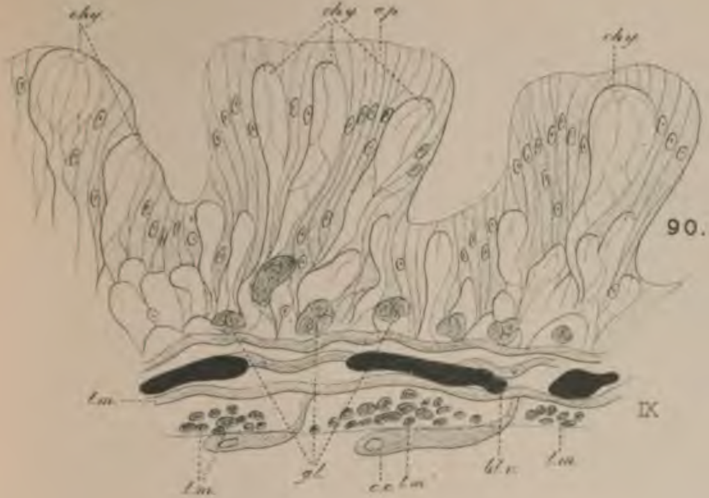


86.A.



GUSTAV EISEN, DEL.

ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 86 TO 89.



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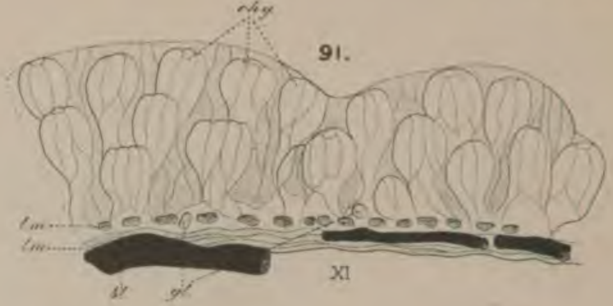

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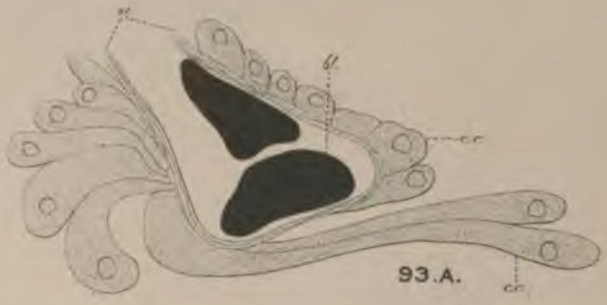
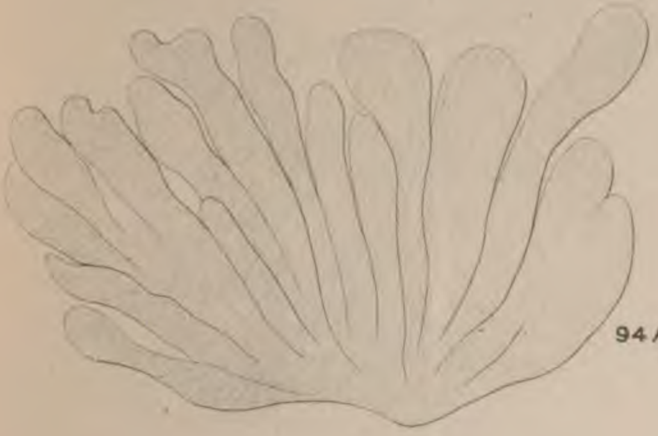
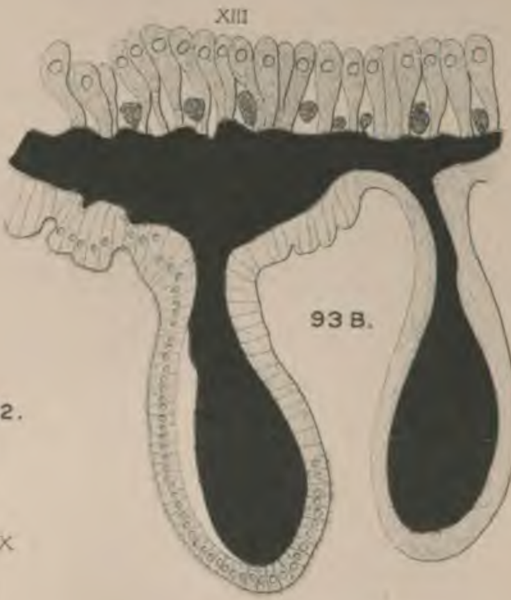


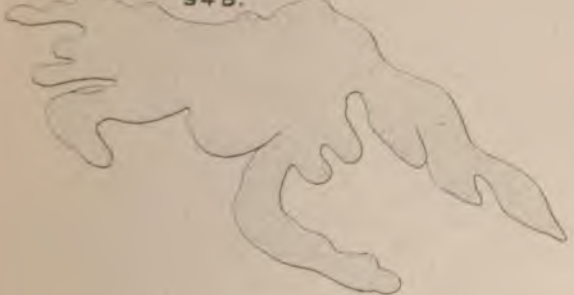
93.A.



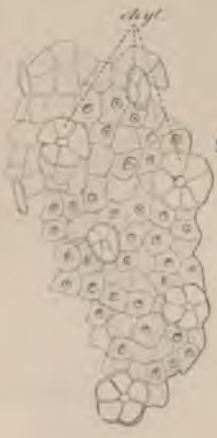
94 A.



93 B.

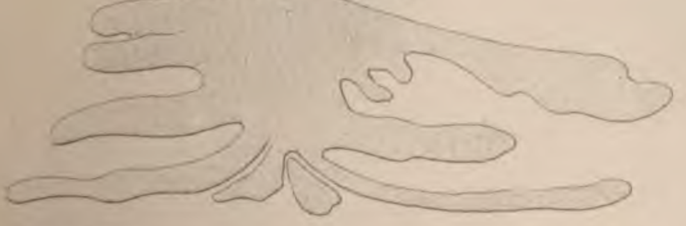


94 B.

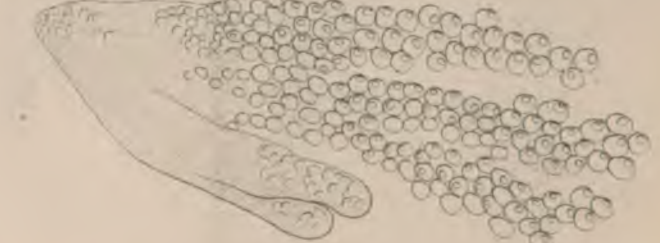


92.

95 B.



94 C.



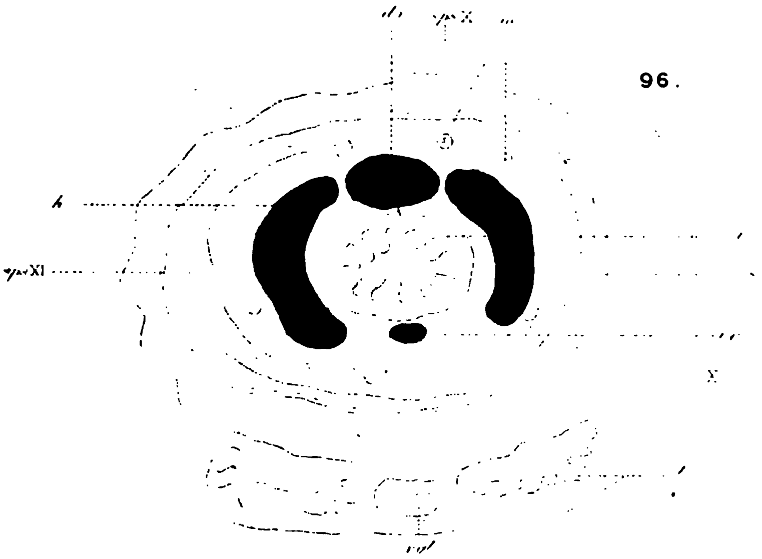
95 A.

GUSTAV EISEN DEL.

LITH. BRITTON & REY SF.

ARGILOPHILUS MARMORATUS, ORNATUS FIG'S. 90 TO 95.

96.



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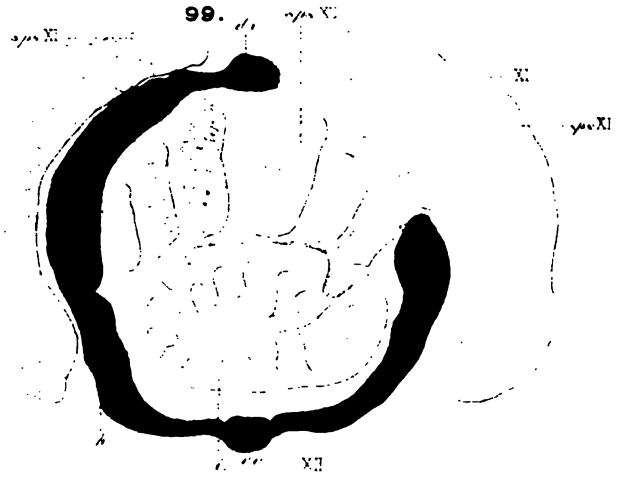

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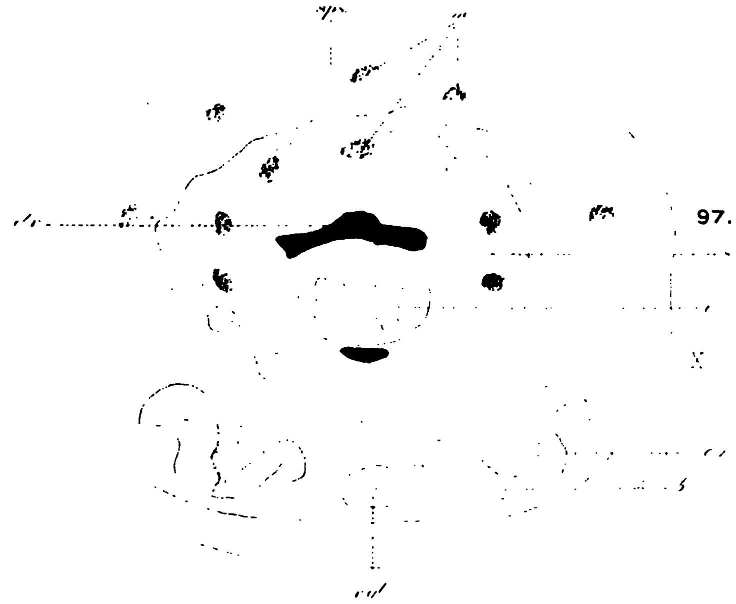

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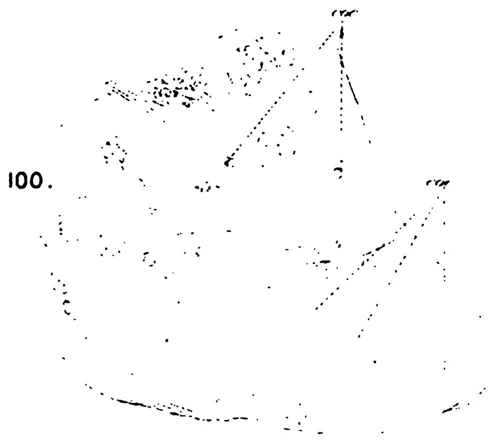

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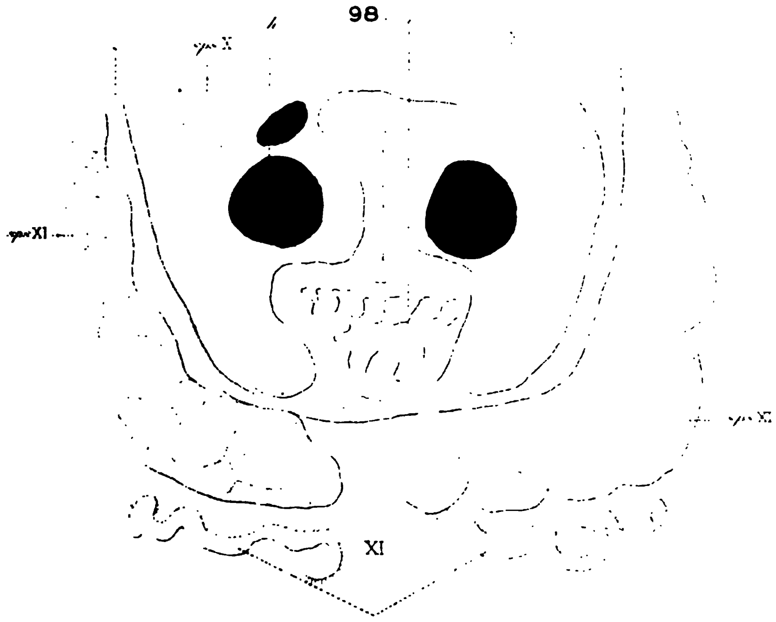

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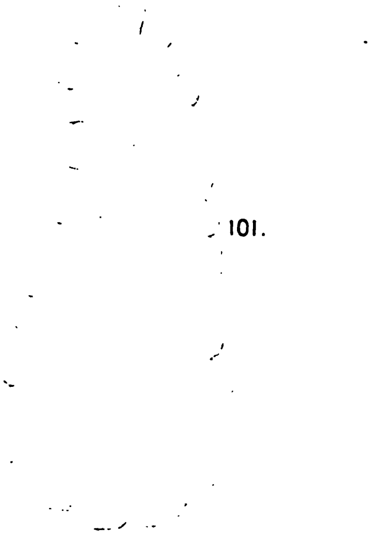

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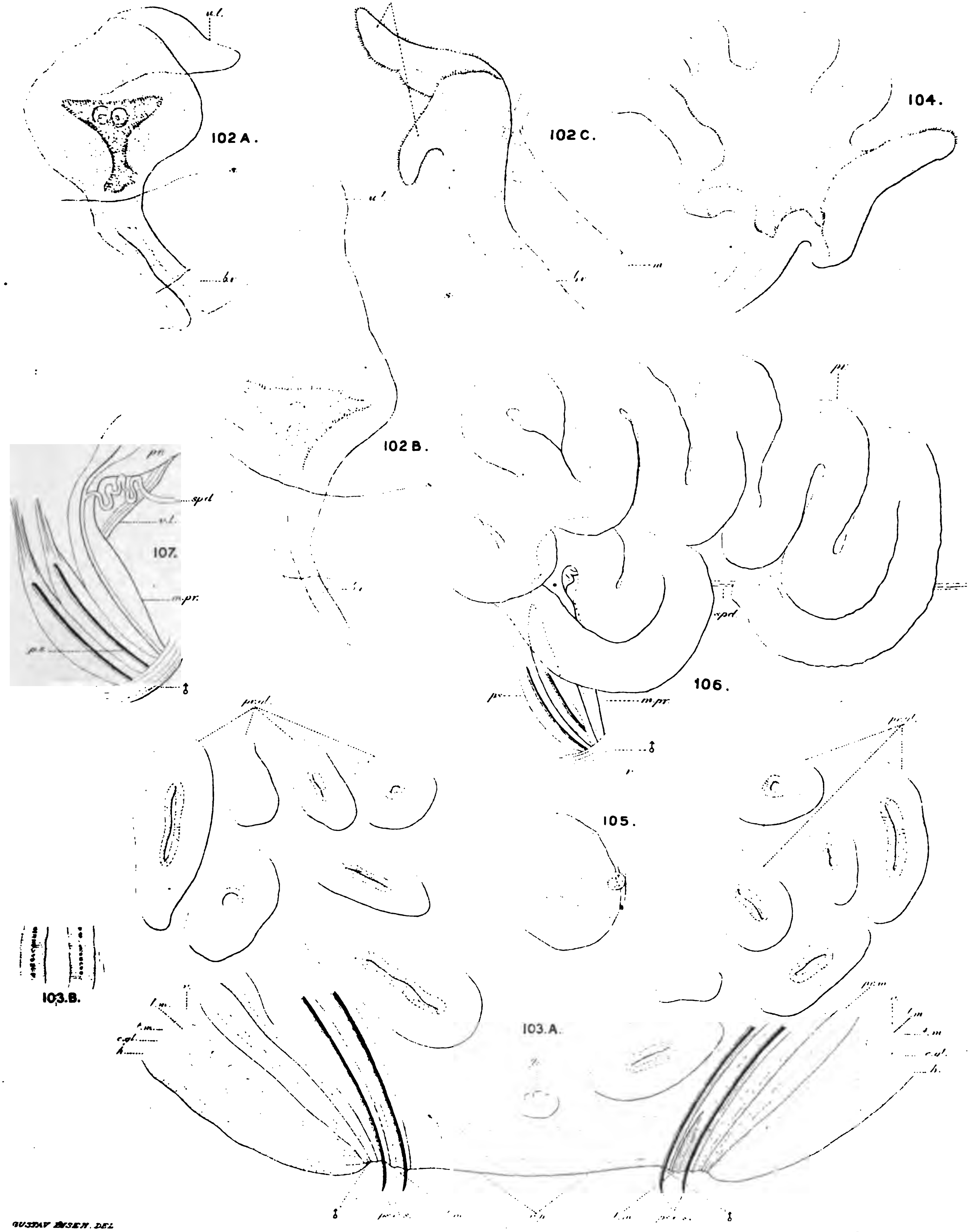
ARGILOPHILUS MARMORATUS ORNATUS FIGS. 96 TO 101.



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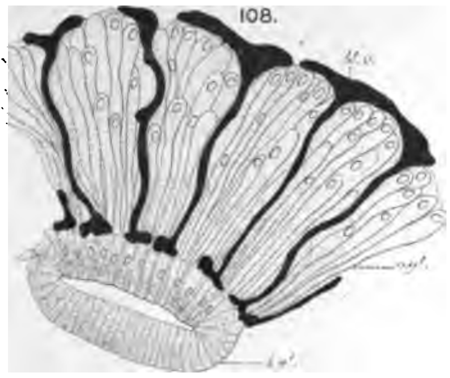
ARGILOPHILUS MARMORATUS ORNATUS. FIG'S 102 TO 107



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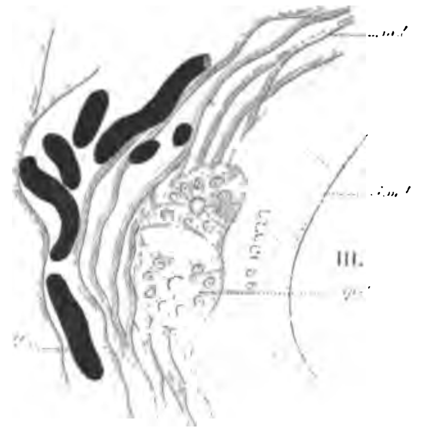
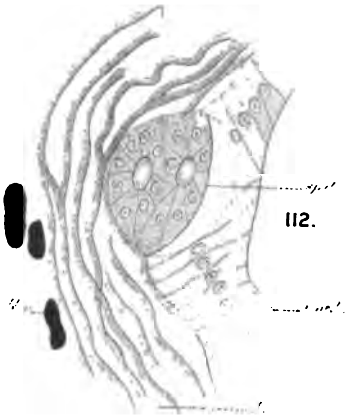


111.



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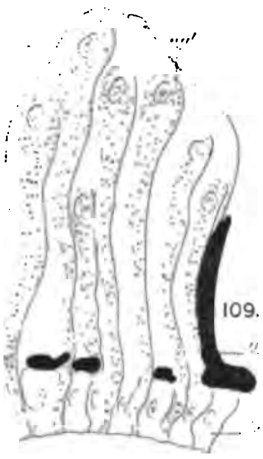

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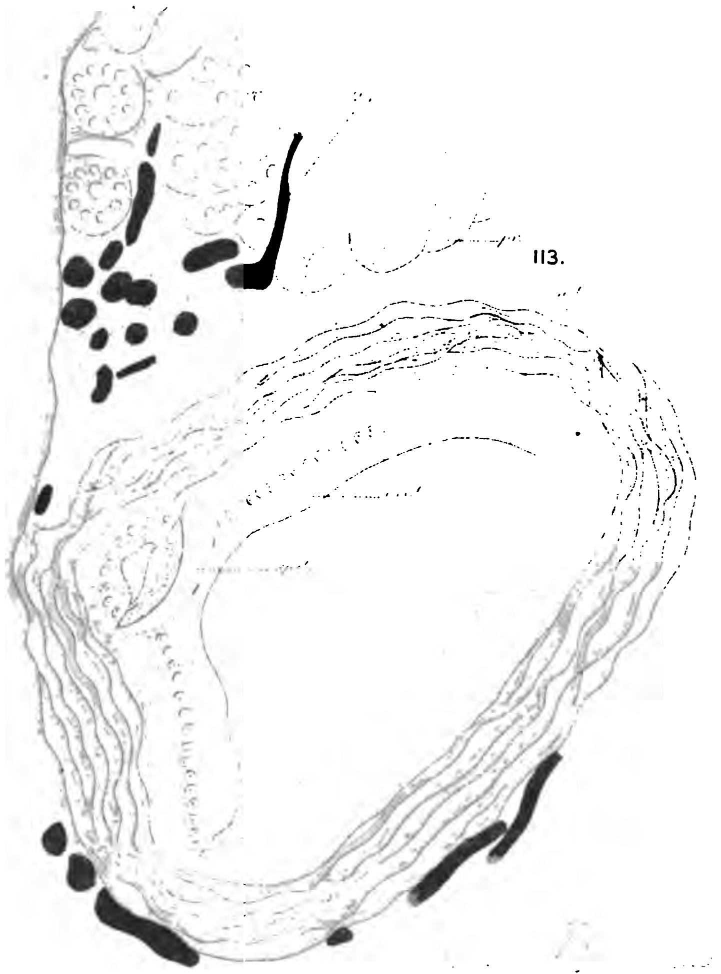

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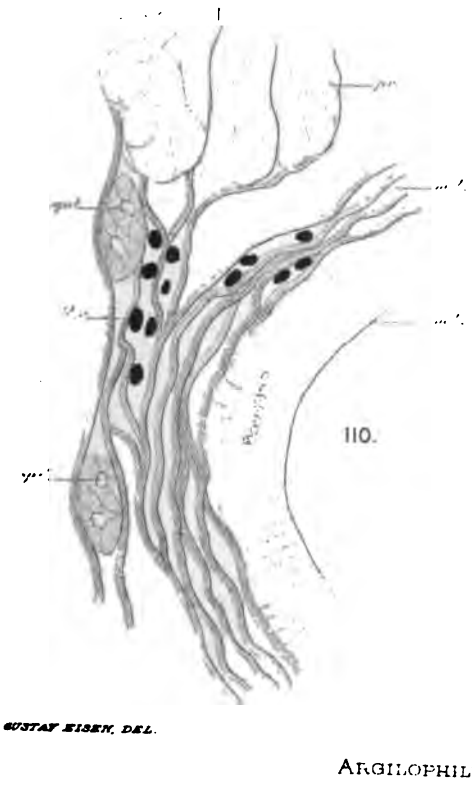

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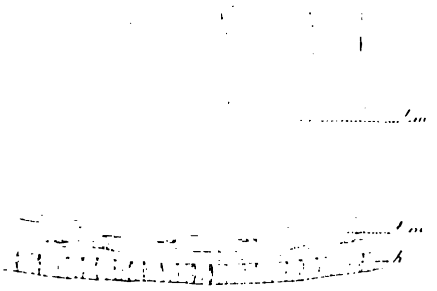

114.

XIX

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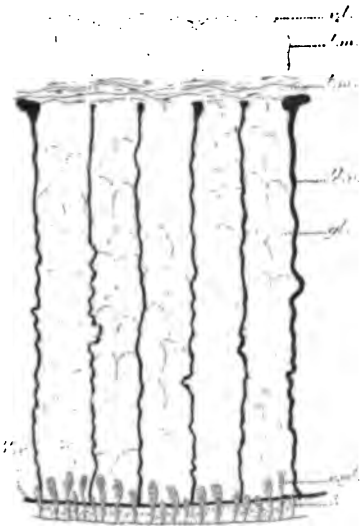
ARGILOPHILUS MARMORATUS ORNATUS FIGS. 108 TO 114.

115.



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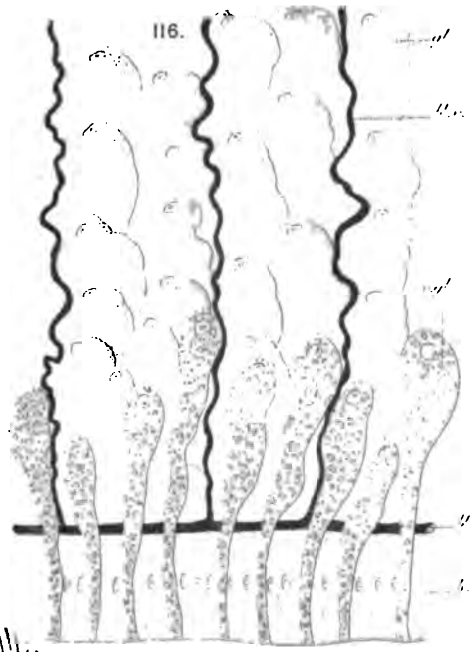

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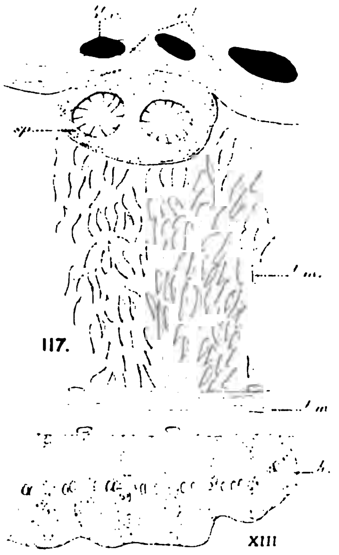
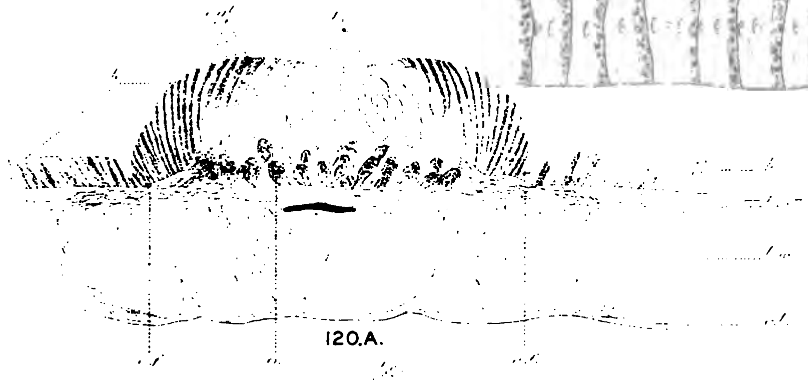
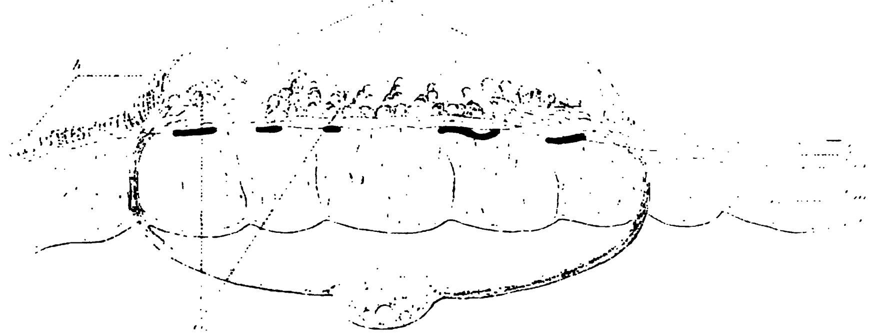


120.A.



120.B.



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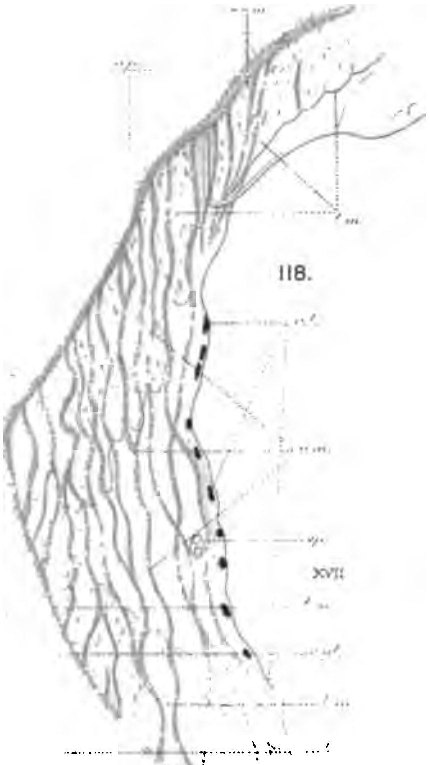

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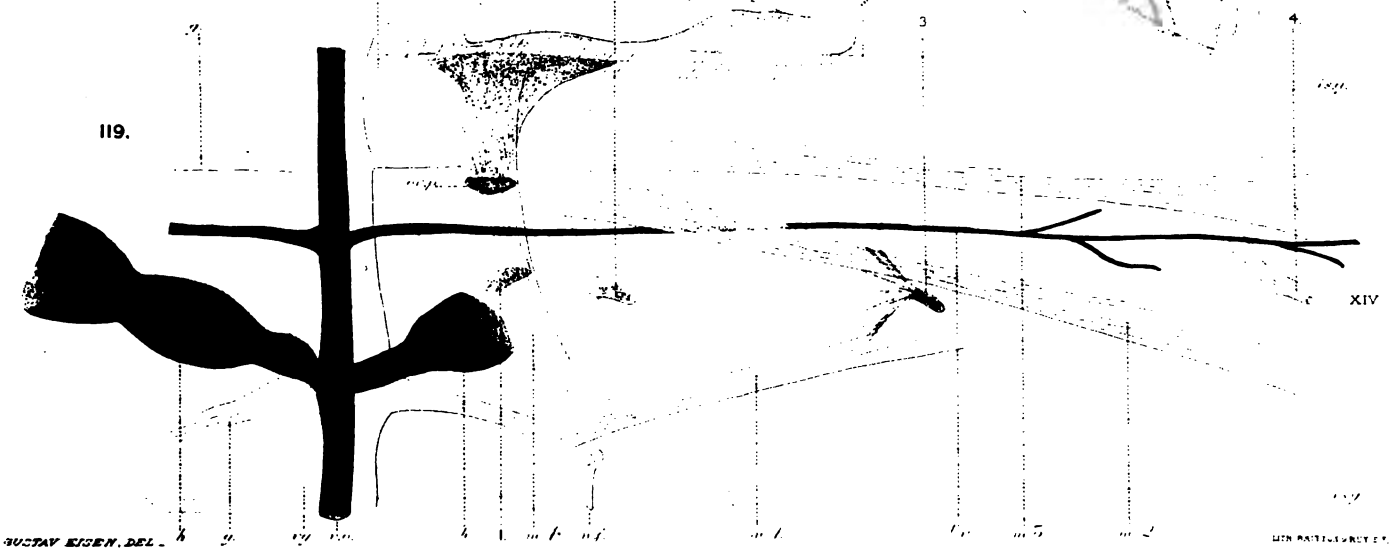

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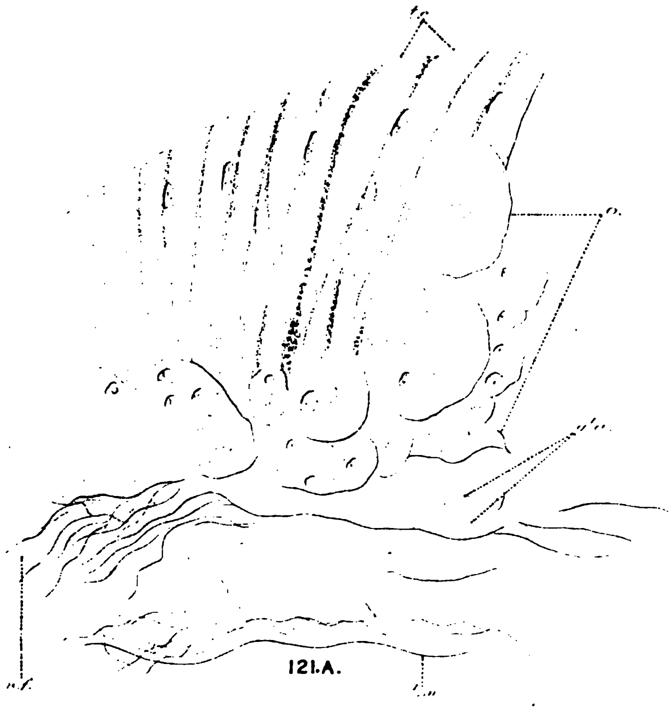
ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 115 TO 120.



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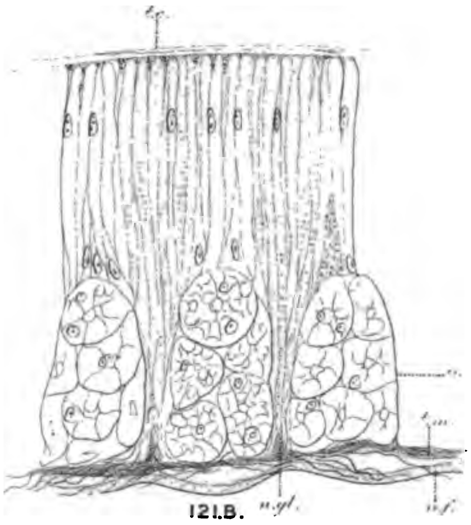
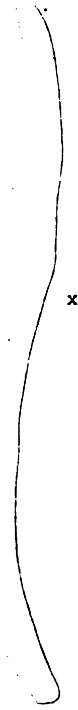
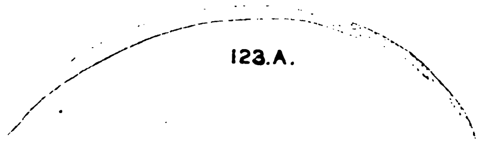


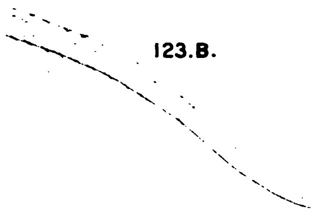
121.B.

122.



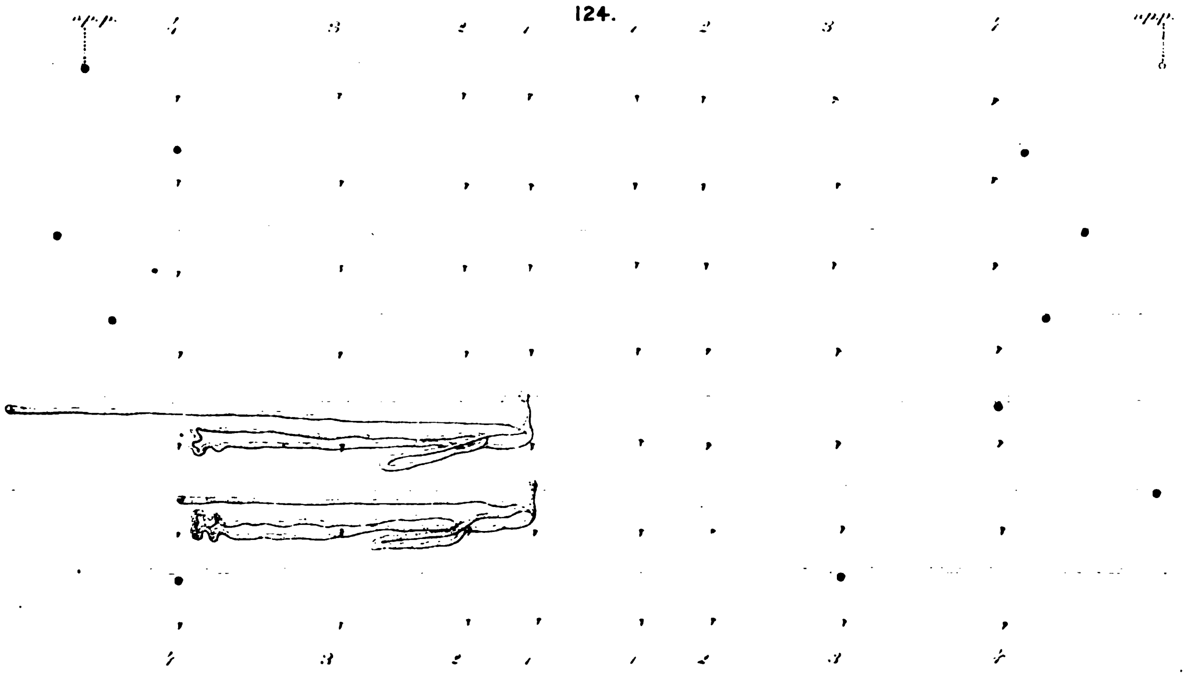


123.A.



123.B.

124.



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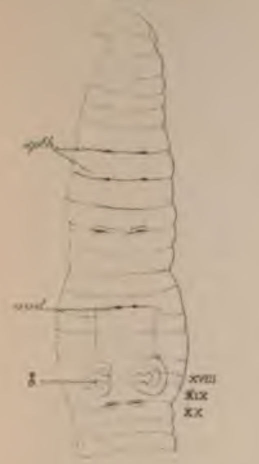
ARGILOPHILUS MARMORATUS ORNATUS FIG'S. _121 TO 124

125.



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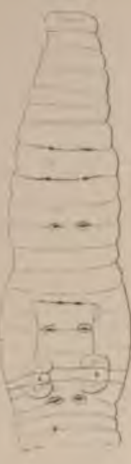

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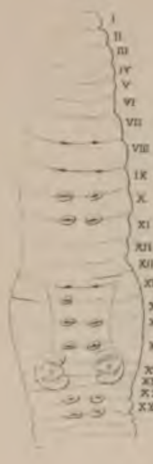
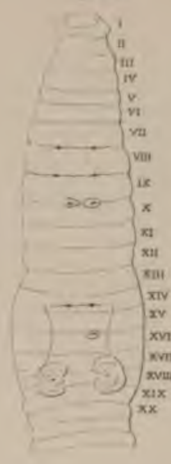


128 A.



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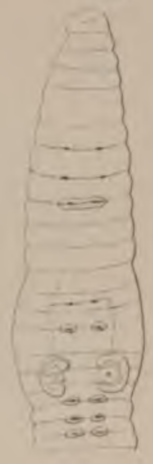

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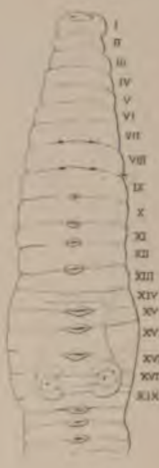

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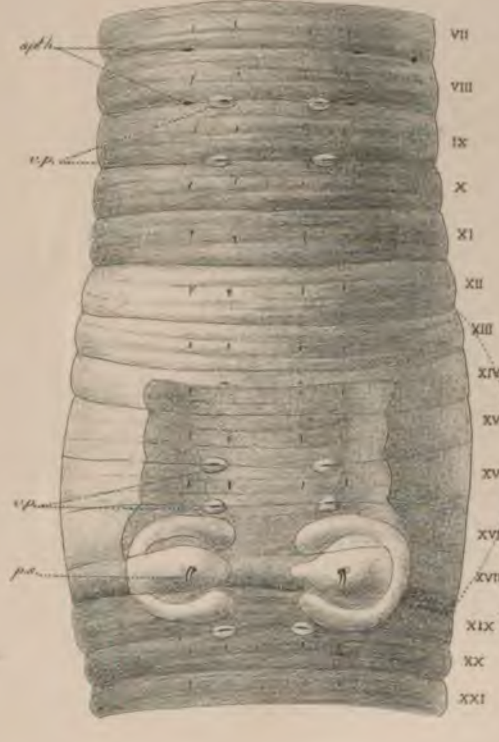
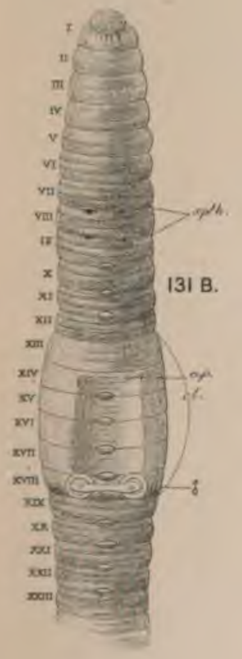
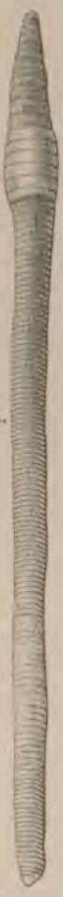


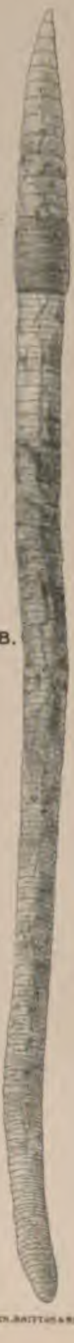
131 B.



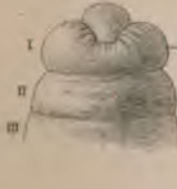
132.A.



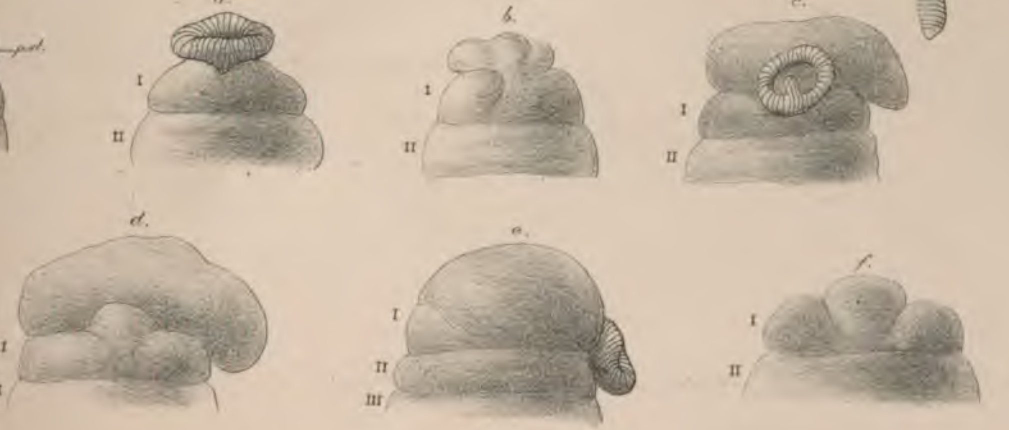
132.B.



131.C.



130.



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ARGILOPHILUS MARMORATUS ORNATUS FIG'S. 125 TO 130.
ARGILOPHILUS MARMORATUS PAPILLIFER FIG'S. 131 & 132.

MEMOIRS

OF THE

CALIFORNIA ACADEMY OF SCIENCES.

VOL. II, NO. 4.

PACIFIC COAST OLIGOCHÆTA.

I.

BY GUSTAV EISEN.

SAN FRANCISCO, CAL.,
MARCH 1895.

PACIFIC COAST OLIGOCHÆTA.

I.

PHŒNICODRILUS TASTE; PONTODRILUS MICHÆLSENI; ECLIPIDRILUS FRIGIDUS.

BY GUSTAV EISEN.

PHŒNICODRILUS nov. gen.

Small slender terrrestrial oligochætæ closely allied to Ocnerodrilus from which genus they differ only in the absence of a prostate. In Ocnerodrilus the organ known as a prostate, or by some as atrium, is a prominent and important characteristic also shared with such genera as Kerria and Gordiodrilus. These genera which form a natural group have been chiefly characterized by one or more prostates, opening either with or independently of the spermducts. Our present form resembles Ocnerodrilus in all principal characteristics which distinguish that genus from Kerria and Gordiodrilus, with the exception that it has not even a trace of a prostate. There are also some other minor characteristics as will be seen from the description, but with the knowledge of only one species it is yet impossible to know if these are genus or species characteristics. For the present the following genus diagnosis may suffice:

Small, terrestrial oligochætæ inhabiting damp soil.

Clitellum imperfect; comprises the oviduct and the male pore.

Spermathecæ with rudimentary diverticula at the inner free end—in ix. The spermathecal pore between viii and ix.

No differentiated penial setæ. The common setæ sigmoid, 8 in each somite in 4 couples.

Nephridia paired, those posterior of the clitellum surrounded by large peritoneal cells.

Alimentary canal without gizzard and typhlosole, but with one pair of large diverticula in ix, connecting with the tubular intestine in the posterior part of the somite. Four pair of septal glands in v, vi, vii and viii.

No subneural vessel. Dorsal and ventral vessel connected by hearts in x and xi. Lateral vessel projected anteriorly from each of the diverticula. Blood yellowish-red.

Testes two pair, in x and ix. Large sperm sacs in ix, x, xi, xii. Ovaries in xiii. Oviduct in xiv. Two pair of ciliated rosettes in x and xi. Sperm ducts not fused, open in the male pore in somite xvii. No prostate.

Phœnicodrilus taste n. sp.

The size is that of a very large Ocnerodrilus though even fully matured specimens varied greatly as to length. My largest specimens, which first had been slowly killed by dropping solution of corrosive sublimate in the water dish and then extended before being hardened with alcohol, reached 2¾ inches by 1¼ line in thickness at the clitellum. Average-sized specimens were considerably over 2 inches long. This refers to the mountain specimens collected in the Sierra El Taste; the lowland specimens from Pescadero were much smaller not reaching the 2-inch mark. The body is slightly tapering towards the tail end. The somites are well set, those of the clitellum are hardly distinct. The prostomium is not long, but broad, dovetailing the peristomium about one-half. From here on the somites gradually, though slightly, increase in size until somite x which is a little the largest, xi, xii and xiii are smaller. The somites posterior to the clitellum are slightly larger than somite x, except the last few posterior ones.

Clitellum comprises somites xiv to viii. Vertically it ends at a line drawn halfway between setæ 2 and 3, slightly receding in somite xiv. Strictly speaking the clitellum does not enclose the male pore, as the pore is situated more ventrally than the thick clitellar layer, and between that and the pore there is no connecting ridge or papilla.

An accessory copulatory swelling is seen around the outer couple of setæ in somite xiv (fig. 26, *c. c.*), the body-wall here being raised like a small mound, with the setæ slightly outside of its center, from which the cells are arranged as radii in a circle.

The male pore is surrounded only by a very small ridge or papilla, not high enough to be seen with a magnifying glass sufficiently strong to reveal the elevated papillæ of the oviducts. But the whole zone around the male pore is often considerably elevated, turned inwards or towards the median line of the body and rounded forming a longitudinal groove.

Exterior pores. The spermathecal pore is situated in the intersegmental groove between somites viii and ix, in front of and slightly outside of seta 2, the inner angle of the pore being in line with that seta, while the body of the papilla is situated more dorsally. The ovipore is situated close by, in front of, but not outside of seta 2. The male pore is situated in xvii exactly in a line with setæ 1 and 2 according to the longitudinal muscular fibres, but as the body-wall is slightly contracted in this somite the pore appears as if situated slightly more ventrally; the exact location is, however, the place left vacant by the absence of the ventral couple of setæ. This couple (setæ 1 and 2) are never, at least not in adult specimens, found developed in this somite, though the tips of the young reserve setæ are sometimes seen in their sac close to the pore.

Nephropores open in line with seta 2, and are situated in the anterior one-third of the space between the setæ and the anterior septum. The pores are large, round and easily distinguished.

Body-wall. The various layers offer nothing of great interest. The longitudinal muscular layer is slightly thicker at the dorsal part, and so is the part situated between the 3d and 4th setæ. The muscles in this layer do not show any feathery arrangement around a central fiber, but are irregularly distributed. There are no dorsal pores. The body-wall in somites xi and xii is thinner than the anterior somites.

Arciform muscles. The inner surface of the body-wall in somites xvii and xviii, and partially also in xvi, are covered with numerous arciform muscles which stretch transversely or diagonally across the body cavity, connecting the region running through the outer couple of setæ with that of the male pore and the inner setæ. The number of muscular bands in these somites is very great and they vary in length and thickness. There is also a slight variation in different specimens, the main fascicles being, however, always in the main the same. These muscles are best viewed when seen from above, the body wall being spread open and the sacculated intestine removed. As will be seen from the drawing, which is a careful representation of the principal muscular bands, most of the bands begin or are attached to the body-wall on a line running through setæ 1 and 2 and ending in a line running through setæ 3 and 4. But there are some which begin more ventrally and end more dorsally than either couple of setæ. In somite xviii most of the fascicles run in right angle to the median line, but the most posterior one as well as one or two more run diagonally backwards. In somite xvii there is one large group of fascicles beginning around the male pore and running transversely sideways, while another group of fascicles run diagonally forward connecting the male region with the anterior part of the somite. There are also longer fascicles anterior of the male pore which run much further sideways than the outer setæ. In somite xvi there are but few fascicles, much smaller and shorter. The male pore and spermducts are so entirely covered up by these muscular fascicles that they can only be seen with the greatest difficulty when viewed on the spread body-wall. In the figure (fig. 7), only the principal muscles of one side are drawn. The shaded bands which are seen crossing the median line are slight ridges in the body-wall, connecting the principal muscle fascicles. The objects of these muscles are of course to elevate and depress the male zone. Similar muscles were first described by Benham in Moniligaster, and later by myself in Argilophilus. They no doubt exist in most species of Oligochæta but are of great interest and value as species characteristics.

The *septa* begin between somites v and vi, and gradually increase in size toward somite ix. The most anterior septum, however, is not unusually thick. The following three septa are very thick, that between viii and ix being the thickest.

Alimentary canal. The buccal cavity is very large and occupies somites i and ii. Pharynx begins in iii or posterior part of ii and extends to the posterior part of iii. It is only developed superiorly and merely attached to the œsophagus in the posterior part of ii. Œsophagus consists of one in the beginning narrow and comparatively even duct, which in iv rises upwards and then becomes considerably sacculated in somites v, vi, vii and viii, again to assume a more tubular form in ix. In the posterior part of this somite it is joined by the two diverticula. The tubular intestine proper occupies the two somites x and xi. In xii begins the sacculated intestine. The diverticula of the œsophagus are very long, narrow and slender, more so than in any species of Ocnerodrilus which I have seen. These exterior features offer nothing peculiar. The lateral blood vessels issue, as usual, from the anterior points of the diverticula.

These diverticula of the œsophagus originate in the posterior part of the somite, and not in the anterior part as in Kerria. The structure of these diverticula corresponds with that of the same organ in Ocnerodrilus. Only in that genus the rule appears to be that the interior of the diverticulum consists of one single chamber encroached on by a few parallel ridges. The diverticulum of *Phœnicodrilus taste* is in the central part four to eight chambered, divided off longitudinally, presenting the same appearance as an orange when cut through crosswise (figs. 14–16). The number of chambers varies, as in one specimen I found the right hand diverticulum to have four chambers, while the left one had five chambers. In sections near to either end these chambers fuse further and finally only two and one chambers are left.

But this fusion is unequal at the two respective ends. In the end nearest the junction with the alimentary canal there is only one chamber found, and a little further forward there are two chambers, the number increasing until generally eight chambers are found in the center. From there on no increase is made, but the chambers decrease in width, and at the anterior end suddenly fuse into one which is small and narrow, not thicker than a blood vessel. The longitudinal blood vesssels are very much the same as in Ocnerodrilus, but generally more in number.

The number of blood vessels in each diverticulum varies with the place where located in the diverticulum. The section nearest to the posterior septum of the alimentary canal shows the two laterals from the dorsal vessel entering the diverticula. To begin with, they are seen on the outside of the cellular mass of the diverticulum, while in succeeding sections they appear like a few blood vessels scattered on the outside of the epithelial cells. In succeeding sections these vessels are seen to increase in number until in the center of the diverticulum they number about one hundred.

The blood supply for these organs come from branches of the dorsal vessel and not from collective vessels from the alimentary canal.

Salivary glands are as usual found attached to the muscles of the pharynx, but they are smaller and less numerous than in Ocnerodrilus, the pharynx being less lobed and more compact than in that genus. These glands open through ducts, which follow muscular strands into the pharyngeal cavity in a similar way as will be more in detail described in Pontodrilus. In fact it is probable that all the suprapharyngeal glands in the respective genera of Lumbricids open similarly and without any great variation as to detail (fig. 18). The narrow ducts from the gland penetrate the pharyngeal epithelium and form at its outer edge small ovoid pockets for temporarily storing a small amount of the salivary secretion. These ducts end with the pharynx, the œsophagal epithelium neither being furnished with ducts nor storage pockets (fig. 18).

The suprapharyngeal glands are posteriorly connected with the septal glands, not only with the nearest pair, but with all the pairs in the respective somites. In *Ocnerodrilus Beddardi* I called the attention to this fact, but I was not able to point out the connection between all the glands, which connection, however, I do not doubt really exists in all genera of this family, and probably in most other Oligochæta.

Septal glands(fig. 2). As regards these glands our present species offers no great peculiarities different from species of Ocnerodrilus generally. There are four pair which surround the œsophagus in the usual way in somites v, vi, vii and viii. The glands are considerably lobed (fig. 1–2), and decrease in size posteriorly. That is, the pair in v is by far the largest, the one in vi is smaller and so on, the one in viii being much the smallest. This gradual decrease in size posteriorly, though the most common one in this class of Oligochæta, does, however, not always exist in all species. I have one species yet undescribed from Guatemala in which all the glands are of the same size. In our present species the glands are distinctly paired, but they lie so close together that that they appear in each somite as one single gland surrounding the intestine. In sections the glands are seen to be abundantly supplied with blood sinsues or larger vessels.

These septal glands (fig. 2), connect one and all with the suprapharyngeal gland, being, so to say, superposed on several main longitudinal muscular bands connecting the pharyngeal glands with the body-wall in somite ix. Wide and narrow ducts follow these muscles, causing the secretions of the septal glands not to empty in the alimentary canal in the respective somites in the glands, but in the pharyngeal cavity as shown in fig. 18.

Fig. 2 is, as far as outlines are concerned, a correct representation of these glands from a section lateral to the œsophagus. Most details, however, are not filled out. The glands on the upper side are those above the œsophagus, the lower row again those below the œsophagus, both opening on the upper side of the pharynx.

The *setæ* occur in couples of two, as usual, the distance between setæ 1 and 1 being about the same as the distance between 2 and 2. The shape is the usual sigmoid one found in Ocnerodrilus, and the size is rather large. The free points are slightly corrugated. The setæ occur in all somites after the first, but there are never any developed setæ where should be the inner couples in xvii. Very small undeveloped tips may sometimes be seen close to and lateral to the male pore enclosed in the reserve bag, but even they are not always present.

The blood vessels agree in all respects with those of Ocnerodrilus. There are two pair of hearts, one each in x and xi and one pair of connecting vessels in ix.

Nephridia are found in all the somites except the first few anterior ones. In somites iii to v the nephridia are very small and dwarfed, but from there on posteriorly they increase in size. Those in front of the clitellum are not furnished with a glandular covering of peritoneal cells; those in the clitellum show a few of those cells, while the nephridia posterior to the clitellum show a highly developed envelop of peritoneal cells, similarly as is the case in some species of Ocnerodrilus. In our present form the difference between the anterior and postclitellar nephridia is very marked, the latter ones being prominently visible through the body-wall both in alcoholic specimens as well as in alive ones. As regards the form of the nephridia, it agrees in general with that of the various species of Ocnerodrilus, some of which I have re-examined. The windings of the canals as well as the general arrangement of the ducts is much the same in the genera which I have examined more in detail, such as Ocnerodrilus, Kerria, Deltania, Argilophilus, Pontodrilus. Especially is this the case with Ocnerodrilus and Kerria, the nephridia of which have been misunderstood, in several particulars, especially so as regards the windings of the canals and the presence of blood vessels.

In Ocnerodrilus as well as in Phœnicodrilus the nephridium consists of two distinct parts, A, the folds, with the winding canals, and B, the peritoneal covering, with more or less numerous blood vessels. The peritoneal covering again is also divided in two parts, one upper almost free, and one lower surrounding or at least adjoining the canals, about which more later on.

In Phœnicodrilus the nephrostome leads to the narrow duct which connects with the folds of the main nephridial body. The folds of these canals are placed on the outside of or rather on the upper edge of the peritoneal covering. The narrow duct when it enters the fold is very narrow, in fact conspicuously so. In the neck of the nephridium it coils itself several times around the part of the wide duct that is enclosed in the neck. Retaining its narrow size it enters the anterior fold, in which it is the most anterior and exterior canal, but nowhere does it appear to ramify as in Pontodrilus, Deltania, Argilophilus, etc. It retains its narrow size all through the windings (fig. 12), but increases in size in the posterior fold, in which the three canals are of equal size.

In the apex of the spur, which as usual is thicker than the fold, the continuation of the narrow duct connects with the very wide canal which later on forms the bridge. After passing the bridge this wide canal becomes much narrower but still continues as thicker than the other canals until it enters the posterior fold. It is also less coiled than any of the other canals, in fact it is most conspicuous by being very straight—it always occupies the under and inner side of the folds. Even in the "windings," which, in this species, occupy a very large part of the folds, this canal is straight, while the two other canals are coiled and bent. We thus find in this genus all the principal parts of the nephridium of the much larger Argilophilus, and it may be safely stated in all highly developed Oligochæta the structure of the nephridia are in the main the same. As far as I am aware we may distinguish the following divisions of a perfect nephridium:

a. Nephrostomal part.
    - Nephrostome, or funnel.
    - Neck of nephrostome, consisting of glandular cells.
    - Narrow, or nephrostomal duct.

b. Main glandular part.
    - Neck of glandular lobe, connected with the nephrostomal duct.
    - Anterior fold.
    - The windings, or the coiled part of the two folds.
    - Posterior fold, in which the three canals are of the same size.
    - Spur, with four canals.
    - Bridge, with only one canal.

c. Efferent part.
    - Wide terminal-duct or outlet. The latter is frequently furnished with a cœlomic bladder.
    - Nephropore.

When the nephridium is spread out and mounted in glycerine it is seen that the canals are of different transparency. Thus the wide canal coming from the bridge, together with its continuation in the spur, is much darker than the two other narrow canals, which are conspicuous through their brilliancy. These two white canals meet in the very apex of the spur, while the two darker canals meet a little further in. The greater obscurity of the wider canal is partly due to ciliation.

The nephrostome of *Phœnicodrilus taste* is furnished with a large neck, almost as large as the rosette, containing several very large cells with conspicuous nuclei. The nephrostome is about as long as the narrow tube.

In size the nephrostome ranges with the very largest, it being conspicuous and readily dissected.

The marginal cells vary in number between eight and fourteen. There is a larger central nucleus as usual. The glandular neck of the nephrostome contains two of these nuclei much larger than any of those found in the rosette, though it also contains several smaller ones. When the body of the annelid is laid open and viewed from above, the nephrostomes are seen to lie on their side as in fig. 9, the side of the thick rim of the rosette being uppermost. In order to see the rosette flattened out it is necessary to dissect out the nephrostome, which operation in this species is not particularly difficult, as the muscular tissues easily separate.

The peritoneal covering of the posterior nephridia separates itself in two distinct masses, one dorsal and one ventral, the latter being somewhat the smallest. At the point where they join the peritoneal covering has narrowed down to a narrow band connecting the two main parts.

The upper peritoneal mass does not surround or contain any of the canals or ducts, but appears to be merely an appendage, a gland, as it were, engrafted on the lower part. The canals and tubes are entirely confined to this part, as is also the case in the nephridia of Ocnerodrilus and Kerria.

The peritoneal sac consists of very large cells with small, sharply defined and very round nuclei. When these cells are empty they are very transparent and their walls are very plain. There are a few blood vessels on the peritoneal sac, and few of these cover also the folds.

Nephridia of Kerria (fig. 23). Having recollected *Kerria McDonaldi* in the pond near Miraflores in the Cape Region of Baja California, the only place where it is found to date, I have taken the opportunity to re-examine the nephridia in order to ascertain their resemblance to those of our present form as well as Ocnerodrilus. As a consequence I am able to correct some errors and to add several details. The general structure is the same as in the Ocnerodrilus and Phœnicodrilus and the windings of the canals the same as in the Argilophilus, etc. The two folds make a large rounded loop upwards, and join posteriorly in a very long spur partly free from peritoneal covering. The bridge connecting the junction of the spur and the posterior fold with the junction of the anterior fold, wide duct and narrow duct, is wide and ciliated, in fact it is the widest part of the canal. Posteriorly the canal of the bridge projects into the spur forming the widest of the four canals in this part. At the apex of the spur two and two of these canals are seen to join as usual, forming two loops, one outside of and above the other. The inner and lower one of these is the bend of the ciliated canal from the bridge, but it does not appear to be ciliated at this point.

The posterior fold contains as usual three canals, and so does the anterior fold. The rounded stretch where the two folds meet is more irregular in outline, and contains more windings than any other part of the fold, though not as many as in Pontodrilus. The nephrostome is connected with the main body by a slender and narrow tube, the connection being a little in front of the one between the wide duct and the main body. This wide duct is almost straight with only a slight curve away from the nephridium. It becomes slightly wider towards the nephropore, just before reaching which it turns sharply upon itself.

Another point of considerable interest is the presence of numerous blood capillaries on the nephridia, especially in the peritoneal sac, which they permiate. The blood has its origin from two vessels, one from the branch from the ventral main vessel and one from the branch from the dorsal main vessels, the two connecting by capillaries on the nephridial folds. Until now it has been supposed that Ocnerodrilus and Kerria did not possess blood vessels on their nephridia, but this is evidently an error as far at least as some species are concerned. Ordinarily these vessels are not visible and not distinct from the peritoneal cell-walls but a staining with orange G. will bring them out at once.

The *generative organs*, with one or two exceptions, resemble those in Ocnerodrilus in form and general arrangement, and if it were not for the regular absence of a prostate our species would be considered as a true Ocnerodrilus. The Spermatheca is very large and resembles in general outline that of *Ocnerodrilus Beddardi*. In species of Ocnerodrilus the spermatheca always stands up and is pressed close to the anterior septum. In *Phœnicodrilus taste*, however, the spermatheca lies always flat pressed against the ventral side of the body-wall, and is of sufficiently large size to reach as far backwards as to the posterior septum between ix and x, which makes it about equal in length to the diverticula of the œsophagus (fig. 1, *spth.*) The lower part of the spermatheca is as usual more muscular than the free end, which in this species is more or less, though always shallowly, lobed, showing a large number of incipient diverticula irregularly formed and arranged. The spermatozoa are found principally in these warty diverticula.

Testes are very long and situated as usual in x and xi. The posterior one at least, and propably both pairs, connect with the sperm-sacs in the same somite.

Sperm-sacs are arranged as in some species of Ocnerodrilus. They are all paired. The anterior pair in ix is attached to the posterior septum of that somite. This pair is very much lobed, the lobes being more in number and in shape more round than in any species of Ocnerodrilus, the pair resembling two bunches of large grapes, completely filling the whole available space in the somite, especially above the diverticula and the œsophagus. The sperm-sacs in x and xi are less or hardly lobed, connecting with the the testes below, the latter, being long, slender and not branched, reach across the somite and joining the sperm-sacs in the posterior part near the septum. The sperm-sacs in xii are connected directly with those in xi, but otherwise attached to the anterior septum of somite xii. This pair of sperm-sacs are lobed but not as much so as those in ix.

There are two pair of ciliated rosettes in x and xi, and two pair of spermducts as usual leading from them. The spermducts join, as is generally the case, forming a single strand which runs close to, but a trifle more dorsally, than setæ 2, until somite xvii is reached. In this somite each spermduct enters a small muscular atrium devoid of prostate, and entirely confined to the longitudinal layer of the body-wall. As soon as entering the body-wall and this muscular chamber the two lumens of the spermduct, which until now had been separate, fuse together and enter the muscular chamber as one single duct.

As atrium I consider a small muscular chamber entirely confined to the body-wall, in which the spermducts open. This chamber is, however, devoid of any glandular cell prolongation such as we are accustomed to find in Ocnerodrilus, and ordinarily it ends where the spermducts enter, which is at the upper end of the layer of the body-wall. The atrium itself consists of an inner layer of epithelial cells, which at the very pore are much larger and furnished with larger nuclei, but which gradually decrease in size as they approach the place where the spermducts enter. This layer is a direct continuation of the hypodermal layer of the body-wall. An outside layer again consists of fine muscular fibres with smaller nuclei directly continued from the transverse muscular layer of the body-wall. We see thus that this short chamber might in reality be nothing but the remnants of a degenerated atrium, or rather remnants of the lower muscular part of a degenerated prostate, which glandular prolongation has disappeared. That this is the case I judge from the structure found in one specimen differing from any other which I investigated. Out of six specimens which I sectioned off five agreed in all particulars as regards the absence of a prostrate, as generally understood in Ocnerodrilus, neither did seven specimens which I dissected show any trace of such a prostate. One specimen which I sectioned, however, showed an abnormal prolongation of the muscular chamber, in every particular resembling the lower muscular part or the atrium proper of the prostate as characteristic of Ocnerodrilus. It ascended inwardly in the cavity of the body as high as to setæ 3 and 4, ended here blindly without any differential glandular part or prostate proper, as is always found in Ocnerodrilus. Such "returns" to original characters and ancestors must, of course, be expected, and are the more interesting when encountered. We might on the other hand consider *Phœnicodrilus taste* as standing on a lower grade than Ocnerodrilus, the prostate not having yet appeared. But against such a view speaks the fact that her organs are as highly developed as in Ocnerodrilus, which would hardly be expected of a lower form, in which we would naturally look for a lower degree of development in several organs at the same time. A degeneration of a certain organ, however, such as the prostate, would not necessitate a similar degeneration of several other organs at the same time.

The absence of a prostate in Phœnicodrilus is of considerable interest, and I think it clearly demonstrates that the absence or presence of this organ cannot be laid at the foundation of families. Such absence of the prostate in an Ocnerodrilide is not unexpected. A perusal of the various species of Ocnerodrilus shows us how these species may be arranged in a series according to the size of the prostate, the list being headed by *Ocnerodrilus occidentalis,* with a very extended prostate, while at the other extremity we find *Ocnerodrilus Hendriei* with the most diminutive prostate, not extending outside of the somite. There is thus only a step further to Phœnicodrilus where this organ is entirely absent. That this fact will have some influence upon our views of the classification of Oligochæta is evident, and several genera or even families which hitherto have been considered far apart solely on account of the presence or absence of a glandular prostate, must now be brought closer together.

Ovary and *oviduct* occupy the same somites as in Ocnerodrilus and offer no characteristics of interest.

Habitat. I found this species in the Sierra el Taste, in the Cape region of Baja California, some 40 or 50 miles north of Cabo San Lucas, at an altitude of 4,000 feet. Later on I found specimens in great number in a garden at Pescadero on the Pacific coast, on the western slope of the same sierra, but at an altitude of only a few feet above the ocean. The water used for irrigation was taken from a creek coming from the sierra.

The species lives in damp soil and occur in great numbers, not mixed with any other form as far as my experience goes. The distribution of the species is most interesting as on the eastern side of the Sierra in the valley of San José, I never found any other Ocnerodrilid than *Ocnerodrilus Beddardi.* The question if the Sierra really absolutely divides the habitats of the two only forms of this family found in the Cape Region, further explorations are necessary to decide.

PONTODRILUS Grube.

The genus Pontodrilus, together with Photodrilus, is distinguished from all related genera by the absence of nephridia in the twelve anterior somites. In the majority of species the nephridia commence in somite xiii, but in two species they commence respectively in xiv and xv. A common character to all the species appears to be the very great thickening of the septa between somite v and xiii.

I have so far on the Pacific Coast only found one species of the genus Pontodrilus. Examinations were made from alcoholic specimens, I having no opportunity to examine them when I found them in their native habitat—Mexico.

Pontodrilus Michaelseni n. sp.

This species differs from all other species, except *P. Maronis*,* which have been referred to this genus in possessing a glandular crop occupying somites xiv, xv and xvi, as well as in other minor details. The habitat of the species is the very narrow moist line between high tide and dry soil on the shores of the Gulf of California around Guaymas, Mexico. The soil in which it occurs is very sandy and thoroughly soaked or moistened with the strongly saline water of the gulf. It occurred here in large numbers, but unfortunately at my visit most of the specimens were immature, only two possessing clitellum in the end of November, 1893. I dedicate this species to Dr. W. Michaelsen of Hamburg, whose labors in our common field are among the the most thorough and best.

EXTERIOR CHARACTERS.

The body of this species reaches a length of 3¼ inches with a width at the clitellum of less than ⅛ of an inch, but the majority of specimens are somewhat smaller. The above measurement refers to specimens slowly killed and then hardened in alcohol. The body is tapering towards the tail end, the latter however being slightly swollen (fig. 24).

The prostomium encroaches on somite i, dividing it about one-half. Somite i is slightly larger than any of the following somites (fig. 25).

The clitellum commences in xiii and in full-grown specimens includes part of xix. It is incomplete in a peculiar manner. In xiii to xvii inclusive it is only developed on the dorsal side of the body. But in xviii and in part of xix the clitellum is only developed on the ventral side of the body, though this fact cannot be ascertained from exterior inspection. Viewed from the underside the clitellum appears to be on a line drawn through seta one. Between xvii and xviii the clitellar swelling recedes slightly, again to widen out in xviii, and here joining to a pair of ventral cushions, between which and the clitellum proper are situated the male pores.

Another pair of swellings are noticed around the spermathecal pores, covering on either side parts of somites vi, vii and viii (fig. 26).

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* I received M. Perrier's memoir on Pontodrilus only after this paper was partly in print.

External pores. There are no dorsal pores. The spermathecal pores are found between somites vii/viii and viii/ix in front of seta 2, each one situated on a slightly elevated cushion. The ovipore in xiv in front of seta 1. The male pores are in xviii in front of and in line with seta 2 (fig. 26 ♂). The nephropores are in front of seta 2.

Setæ. The setæ commence in somite ii, eight in each segment and in couples. The distance between 3 and 4 is only slightly larger than that between 1 and 2. The distance between 1 and 1 is nearly twice as large as that between 1 and 2, and the distance between 2 and 3 is a little smaller than that between 1 and 1 (fig. 27).

Color of body pale flesh, rather transparent and marbled very much like Deltania. Clitellum yellowish.

INTERNAL ANATOMY.

Body-wall. The body-wall appears to me to be of unusual thinness, throughout the length of the body. The dorsal side is slightly thinner than the ventral side, at least anterior to the clitellum (fig. 29). Dorsally the longitudinal muscular layer is of about the same thickness as the transverse layer while on the ventral side the longitudinal muscular layer is about twice as thick as the tranverse muscular layer. This refers to the anterior somites. To this there is however an exception in somites viii and ix where on the ventral side in the vicinity of the spermathecal pores the transverse layer is thicker than the longitudinal layer. The transverse layer tapers down towards the spermathecal pores, but this thickening is found only in the immediate vicinity of the spermatheca. In the clitellar somites the relative development of the muscular layer is very different. Here the inner or longitudinal muscular layer is enormously thickened laterally in somites xvii and xviii or in the vicinity of the male pores (figs. 37, 38, 40, 41), while in the anterior part of the clitellum the longitudinal layer is only thickened ventrally, between the inner couples of setæ it here being at least twice as wide as it is dorsally (fig. 39).

Clitellum offers many points of interest. It has already been stated that this organ is incomplete, that is, not simultaneously developed on the dorsal and ventral sides. A section through an immature specimen shows (fig. 38) that the clitellar glandular layer is developed only between the seta, that is, from seta 4 ventrally to seta 4, while dorsally there is no trace of such cells. As regards the nature of these cells it is to be remarked that they are unusually small or rather thin compared to the larger and thicker cells of the dorsal part of the clitellum in the anterior somites of that organ. These latter cells offer nothing in particular of interest, resembling those of other genera of the family as far as I can make out. Unfortunately most of the specimens were immature and only two possessed clitellum, but these two had unavoidably not been treated, and had contracted to such very great extent that the finer structure of the clitellum had been hopelessly lost. From cross and longitudinal sections made it was, however, evident that the clitellar glandular cells, which constitute the clitellum, do not extend ventrally further than to setæ 1, thus leaving the ventral space between setæ 1 and 1 with the usual layers less the glandular cells (fig. 41, *b. cl.*) marking the points where the clitellum ceases. We have thus before us a species with a dorsal and lateral clitellum in some somites, and with a ventral and lateral in one somite.

In all of the clitellar somites the inner or longitudinal muscular layer possesses an enormous development laterally, especially so in the region of the prostate, where it reaches a width four times that at the dorsal and ventral part. The reason of this enormous thickening of this layer is readily understood when we view one of the sections of this region. The part of the body-wall, on which rests the prostate, is attached by numerous arciform muscular bundles, arranged in a fan-shaped manner, to the dorsal and lateral sides of the body. These muscles are more numerous and stronger than any I have seen described in other species, making it possible for this region of the body to contract in a most characteristic manner.

When the body is opened and flattened out these muscles are seen to spread out from the male pore laterally, connecting the center of somite xviii with the two nearest somites xvii and xix as I have endeavored to show in fig. 42. As may be judged from the figure the muscles are arranged in regular fascicles of which we may count twenty-two to twenty-four as being more prominent and overlapping the other—a smaller number of fascicles situated below. The wider periphery of the attachment is situated on the body-wall above the prostate, but the lower and narrower part of the attachment of the fan is situated on a peculiar swelling which I have designated as the copulatory cushion (fig. 42, *c. c.*; fig. 41, *c. c.*; fig. 38, *c. c.*; figs. 44, 45), apparently a thickening of the longitudinal muscular layer, transversed by innumerable other muscles in every direction, all connected by what looks like connective tissue. The size of this copulatory cushion is very great; not only do these swellings project considerably outward but inwardly they encroach to a great extent on the internal cavity, especially so in mature specimens. This peculiar organ is entirely muscular, there being no sign of any outwardly opening papillæ. The prostate pore is situated between this cushion and the projection caused by the increased thickness of the longitudinal layer and the contraction of the fan-shaped muscles. In fig. 43 the section, a longitudinal one, is somewhat oblique, having followed the large muscular strands which surround the outlet duct of the prostate as well as the muscles of the copulatory cushion. Fig. 44 represents a more vertical, longitudinal section, more interior to the large fan-muscles, which do not show in the section except their inner attachments (*a. m.*) The large arciform strands vary considerably in size, those nearest the body-wall being the smallest, those nearest the intestine the largest. When a cross-section through somite xviii is viewed it will be seen that the smaller strands are filled between with connective tissue (fig. 41, *c. t.*), while a concentric transverse muscular strand is crossing them near the inner angle of the prostate pore. Other muscles connect the glandular prostate with the body-wall (figs. 37, 40 *m* and 42 *sp. m.*) The large strand *sp. m* in fig. 42, connects the bend of the prostate, where enters the sperm duct, with the ventral part of the body-wall under the ventral nerve-cord.

Septa. The first very pronounced septum is found between somites iv and v. Beddard has already remarked that the septa in *Pontodrilus hesperidum* are unusually thickened, some of them being thicker even than the body-wall at the point where they are attached to it. The septa in our present form are almost gradually increasing in thickness towards the one between xi and xii, which septum is the thickest, being almost as thick as the ventral body-wall. The septum dividing xii and xiii, while thickened, is much thinner, and those bounding the somites down to xix are almost normal in thickness, that is, equal those posterior to the clitellum. As a rule the attachments of the septa correspond with the intersegmental furrows. The septa bounding vii/viii and viii/ix are, however, exceptions as far as the place of their ventral attachment is concerned. These two septa are here affixed to the body-wall half-way between the setæ of the anterior somites, respectively vii and viii. This makes it appear as if the spermathecæ opened in the centre of the somite, when in reality they open as usual in the intersegmental groove.

Alimentary canal. The alimentary canal takes the shape of a long, narrow duct, singularly straight and without any prominent characteristics until it reaches somite xiv, in which somite commences a kind of gizzard of peculiar construction (fig. 29, *giz.*) Though this organ resembles a gizzard in outward form it is in reality no gizzard at all, but rather a glandular modification of the alimentary wall. With a gizzard we must of course mean an enlargement of the alimentary canal in which the muscular part has reached an enormous development in order to grind the food properly. In the organ referred to in our present species the muscular layers are on the contrary not increased in size, the thickening of the wall being caused exclusively by a new layer composed of glandular cells, which has been interposed between the transverse muscles and the inner epithelium, thus forming a glandular crop between the œsophagus and the tubular intestine. This organ occupies three somites, xiv, xv, xvi, or very much the same place as is so frequently the location for gizzard in other Oligochætæ. If we view a longitudinal section of the body through this crop (fig. 47) we find it to be more or less tapering towards either end. The large longitudinal blood vessel lies almost immediately on the top of the outer or chloragogic cells, in places penetrating them with connecting vessels which supply the underlining sinus with blood (fig. 47, *d. v. c.*).

The chloragogic layer of cells vary considerably in size. Sometimes there is more than one row of cells, one projecting above the other. The nuclei are oval and situated at the place where the cells become narrower. The longitudinal muscular layer is narrow, about two strands thick, immediately superposed the transverse layer, which consists only of one single thickness of strands (fig. 48 to 54 *t. m.*) The case generally observed in gizzards is that this layer is composed of a great number of strands more or less regularly arranged around a central plate. Below this transverse layer, commences the very thick layer of glandular cells, about 12 cells wide in centre. In the upper part of this layer are seen numerous blood lacunes, which in places join the muscular layers (fig. 49 to 53 *bl.*), at other times are more or less perfectly enclosed in the glandular layer, forming generally a row of vascular lacunes near its outer margins (fig. 48 *bl. s.*) apparently without touching the muscular layer, or doing this only at certain places. Figs. 49 to 53 represent cross-section from different parts of the crop, from the posterior part, near the boundary of somite xvii (fig. 49), to the anterior part of xiv (fig. 52), illustrating the variations in thickness of the glandular layer. In the posterior part this layer is very thin (fig. 49 *gl.*) consisting only of a few cells, from one to three cells wide. In figs. 50 to 52 the glandular layer is seen to have increased in thickness and so has the inner epithelial cells. Fig. 53 is a portion of the glandular layer, in which the inner lumen is more plainly represented. The outer part of this glandular layer is divided up in lobes by the numerous blood sinuses, and in each such lobe there is a wider or narrower, generally, branched lumen, which, however, I have not been able to follow down to the epithelial cells.

The sacculated intestine commences at the posterior end of the crop, and offers nothing of great interest or characteristic.

There is no thyphlosole, but the intestine is otherwise very rich in blood lacunes.

Pharyngeal or *Salivary Gland.* Pharynx which occupies somites ii and iii is only developed dorsally. It is superposed by a large mass of glands and muscles, as is usual in a large number of Oligochætæ. In outline this glandular mass is remarkably even, especially so at its posterior end. In a longitudinal section we see customarily three lobes (fig. 29), supported by long strands of muscles, running back to the posterior boundaries of somites vi, vii and viii.

On the ventral side there are seen three of those muscular strands, similarly running back to vi, vii and viii, indicating that there is a row of similar strands corresponding with somites ii, iii and iv. In somite v there is a pair of smaller glands of similar nature attached to muscles which connect with the larger strands of the main gland (fig. 29, *s.s. gl.*)

A cross-section of this glandular mass (fig. 30), shows us that the glands are situated principally on the periphery, supported by muscles (*ms.*), while the inner and posterior part is principally taken up by strands and ducts. A division of the mass in three more or less distinct layers is discernible, probably corresponding to somites ii, iii and iv. These glands communicate directly by means of ducts with the epithelium of the pharynx. In fig. 29 these ducts are roughly represented as dark violet. In the cross-section (fig. 30), the darkest blotches are intended to represent the ducts, while the lighter colored violet ones are the glands. In fig. 31 a lobe of the longitudinal section is seen in a larger magnification, and in fig. 32 a smaller lobe, yet more highly magnified. The glandular cells are rather of varying size, and arranged around the margin of glandular sack, leaving the inner space open. The cell cytoplasm is massed in places, leaving in other places larger or smaller, generally roundish, vacuoles (fig. 35, *va.*)

In figs. 33 and 34 I have endeavored to show the relative arrangement of the muscular strands, the glandular ducts and the glandular cells. As will be seen these ducts are in places entirely closed in by muscles, while the glands themselves are only supported by them.

The ducts lead directly to the pharyngeal epithelium; arrived here they branch out sending numerous discharge-tubes between the epithelial cells (fig. 36 *gl. dt.*), discharging the salivary mucous in the pharyngeal cavity. These ductules are frequently, though not generally, branched while in the epithelial layer. Each ductule is furnished at the distal end with a small storage chamber (36A) of oblong form and considerably smaller than the nucleus of the epithelial cells.

Septal glands. As has already been stated there are five pair of very small glands, which are pricipally attached to the connecting vessels in somites v to ix, and situated on the ventral side of the œsophagus. These glands do not hang on closely to the septum, but are apparently suspended from it only by a few tiny mesenteric tissues and by a muscle or two. In longitudinal section they appear as suspend entirely between the two septa (fig. 29), while in cross-section they are seen to be affixed to the connecting vessels and from them project laterally. the point of affixion being close to the ventral vessels (fig. 70 *gl.*) The general outline of these glands resemble the so-called liver cells attached to the connecting and other vessels in some Lumbricides, but the structure is similar to the salivary glands. The gland in v resembles exactly the structure in the salivary glands which open in the pharynx, it being transversed by blood capillaries, infested with the same parasites, supported by muscles, and finally is only sparcely surrounded by floating, globular, cœlomic cells. The other gland in vi to ix are all surrounded by a thick coating of these floating cœlomic cells. These glands stain in the same way as the salivary glands, their secretions being stained deep violet with hæmatoxylon-orange, while the cœlomic cells stain pale yellow. A fine and very thin duct runs backwards and upwards from the far upper end of each gland towards the alimentary canal to its junction with the septum, but I have some doubt about it emptying into the intestine, and it is much more probable that in Pontodrilus, as well as in Phœnicodrilus and Ocnerodrilus, these septal glands empty into the pharynx. None of my sections, however, show this to be the case. Certain it is that in Pontodrilus the various septal glands are not as closely connected with the salivary glands as in the just mentioned genera, in which the respective glands are actually not only suspended from the same longitudinal muscular band, but along and resting on the latter run also the collective ducts of the glands. Among the salivary and septal glands are seen numerous irregular, generally oval or oblong bodies full of nuclei. These are the terminal pockets of the capilaries, generally termed blood glands.

Blood glands (fig. 73A, *t.*). Ed. Perrier was the first to describe blood glands in Pontodrilus, but he found them exclusively in the blood vessels or at the end of the capilaries investing the nephridia. In our present species, *P. Michaelseni*, I have found these glands only in the capillaries of the salivary and septal glands. They here occur in very large numbers, especially in the former, being massed at or near the posterior edge of the gland in varying numbers. Some specimens contain comparatively few blood glands, others three or four times as many. They are of all sizes and shapes, as Perrier has shown. Some contain only one single nucleus, then frequently surrounded by a blood clot; others again contain a very great number of nuclei, which are then situated in a sac-like pocket at the end of the blood capillary. In some of the larger blood vessels in the salivary gland the blood gland takes the form of a "hertzkörper." The smaller ones situated on the capillaries may be named terminal blood glands, while those situated inside the larger vessels may be designated interior blood glands. The structure of the two are at least in this species very similar.

In fig. 73, *a.* to *s.*, I have endeavored to illustrate the structure of these blood glands from sections. In *g.* a large blood vessel with a blood clot, at the base of which is an inner blood gland. On one side of the blood vessel is a part of a salivary gland with brown secretions. In *a.* a small terminal blood gland is shown, and in *b.* and *e.* some of a greater development. The nuclei are not always surrounded by a distinct cell membrane, in fact in almost every gland are found some nuclei with distinct cell membranes while others lie loose in the granular serum. The exterior line in all the figures represents the wall of the blood vessel, and the difference between the terminal and inner blood glands consist in reality only in the absence or presence of blood surrounding the glands. As far as the granular protoplasm concerns it is always differentiated in two parts. The one at the distal extremity is more evenly diffused and finer grained than the one next the capillary, which again is coarser, streaky and which, besides, stains differently or at least more intensely than the other. Many of the glands contain larger or smaller bodies (*p.*, *t.* and *o.*) equally of round form and lighter in color than the cytoplasm, but sometimes they are very opaque, staining deeply as at *r.*, the two classes probably being of entirely different character. The former resembles a pale nucleus, while the latter opaque bodies appear only to be secreted matter. The paler ones may possibly be parasitic protozoa.

The blood glands described by Claparede, Lankester and others in Lumbricus, etc., are probably of a similar construction, and judging from the figure given by Michaelsen of the "hertzkörper" in Enchytræus, we may conclude that it, too, is identical with the blood gland in Pontodrilus.

Spermathecæ (figs. 30, 55, 56, 57, 58). There are two pair of spermathecæ found in somites viii and ix, the exterior pores being as usual in the intersegmental grooves between vii/viii and viii/ix in line with setæ 2. Each spermatheca possesses a tubular diverticulum, the junction of the two being in the body-wall. The position of the diverticulum is always ventral to the spermathecæ proper. This is cylindrical, quite narrow, with a larger globular chamber at the free inner end, in which the wall is much thinner than in the cylindrical part. At the junction with the body-wall is a much larger swelling, the lower and more strongly muscular part of the main cylinder being greatly widened, presenting a muscular cushion partly projecting above the body-wall, partly again being immerged in it. The spermatozoa are principally massed in the inner globular chamber, though they are seen also in the diverticulum.

The main spermatheca is strongly muscular, especially at its lower end where the muscular layer is much thicker than the inner epithelial cells. These latter are large with oval nuclei. Outside of these cells and between them and the muscular layer are seen a row of interstitial nuclei of much smaller size than the nuclei of the epithelial cells (fig. 56 *intes. n.*) The structure of the diverticulum is somewhat different. Interiorly we find large epithelial cells with large round nuclei. Outside of them is a single row of interstitial nuclei. Surrounding them we find a circular muscular layer varying in thickness (fig. 57, *c. m.*) and with few, small nuclei. Exterior to this layer are seen numerous blood vessels, and outside of them a two or three cells thick layer of glandular cells (*gl. c.*)

When the body of the worm is viewed from the interior, with the alimentary canal removed, the spermatheca as well as their diverticula are seen to extend backward, parallel with the ventral ganglion. The diverticulum is always much shorter and narrower than the spermatheca proper.

Testes and *Ovaries*. The former organs consist of two pair of minute narrow-lobed bodies (fig. 29, *t.* 59, 60), the lobes being all in one plane, parallel to the body-wall. One pair are in x and one in xi as usual.

The ovaries consist of one pair of flat bodies with wavy margin and wide and shallow lobes, distributed in both a horizontal and vertical plane (figs. 61 and 62). As usual the ovaries are in xiii.

The *oviduct* is placed as usual with the funnel in xiii and the pore in xiv. The funnel part is very thick, fig. 63 drawn from a longitudinal section.

Ciliated rosettes, *Spermducts* and *Prostates*. There are as usual two pair of ciliated rosettes in x and xi opposite the testes. The funnels are very thick and not much crimpled or hardly crimpled with one flare on either side. The epithelial nuclei are quite long, and their cells are superposed a thick layer of very distinct blood vessels (fig. 65, *cr.* 66 and 67). The spermducts unite to a single duct which passes immediately outside of the second setæ. The duct is unusually narrow, the narrowest I have seen in any species of this size. The spermduct enters the glandular part of the prostate just above the intersegmental groove separating xviii/xvii (fig. 42, *spd.*; 68, *spd.*)

The prostate is tubular, very large, bent upon itself once. It starts from the male pore, which is situated in the center of xviii, forwards, running parallel with ventral nerve cord. When it reaches xvii it turns backward, its apex being in the center of xviii. The prostate consists as usual of two distinct parts, connected in the center of xvii. The advancing part is strongly muscular, the returning part again is glandular. The prostate is cylindrical, the two halves being almost equal in thickness. The part which penetrates the muscular body-wall is several times thinner than the other part. The muscular part consists of two layers, the inner one consisting of a row of epithelial cells with oblong nuclei. The outer layer, which is very thick, consists entirely of circular muscles with a few small nuclei.

The glandular part of the prostate which commences at the anterior bend of the organ consists of two or possibly of three layers. The inner lining consists of only one layer of epithelial cells with ovoid nuclei. These long cells appear to be surrounded by a narrow zone of fibrous or perhaps muscular tissue with few nuclei. But by far the greatest part of the prostate consists of fibrous tissue with numerous small roundish nuclei, with here and there a cell being visible, and with a few cells of a glandular appearance (fig. 68), especially toward the circumference. In cross-section the anterior part of this prostate is triangular in outline, while the muscular part is always circular, and in size always thicker. The very narrow part of the prostate which penetrates the body-wall is strongly muscular of the same general structure as the free muscular part. The general structure of the prostate appears similar to the one of *Pontodrilus hesperidum* as described by Beddard. He has pointed out the absence of a regular layer of glandular cells in the prostate of that species, and it is possible that this construction of this organ which thus approaches that of Ocnerodrilidæ, is not a species but a generic character, if it does not prove to be of even greater value.

Vascular system. There are a dorsal and ventral vessel, but no subneural, nor any subintestinal vessel, and no thyphlosole. The two main vessels are connected with hearts in x, xi, xii, xiii, the most posterior one of which is found in somite xiii, immediately in front of the sacculated intestine. This heart is the largest, the others gradually decrease in size forward. The posterior part of these vessels are entirely free of brown cells. The ventral vessel is forked in somite ix in two parallel lateral vessels, there being no central vessel left. These two branches are always of unequal size, both being situated immediately under the œsophagus (fig. 64 *v. v.*) In the somites anterior to x, these branches of the ventral are connected by laterals with the dorsal vessel. In one specimen the ventral fork commenced in xii (fig. 64).

Between the dorsal vessel and the ventral forks there are connecting vessels, one pair in each of the somites v, vi, vii, viii and ix. To the ventral parts of these connecting vessels are attached oblong glands, which again are surrounded by a coating of globular brown cells. These glands do not extend clear to the dorsal vessel, but end laterally before reaching it. The nature of the glandular cells appear the same as those of the pharynx, staining in exactly the same way. The cells of these septal glands are more numerous in the anterior somites, gradually diminishing posteriorly, while the opposite is the case with the free round cells which are more numerous in the posterior glands (figs. 29 *gl.* and 71 *gl.*)

Nephridia (figs. 71 and 72). These organs commence in somite xiii, or in the same somite as the ovaries. The first two anterior nephridia are furnished with a smaller covering of peritoneal cells, but already in xvi do the nephridia attain their full size, as in all posterior somites.

The nephridia are built upon the same general principles as those of Argilophilus, Deltania, Ocnerodrilus and Phœnicodrilus, as well as of Lumbricus as shown by Benham. We find here the corresponding ducts, canals, lobes, etc., and a general description of them will be superfluous. The spur is directed backwards and the two folds are directed upwards in about right angle to the spur and narrow duct as well. The spur and the folds rest on the large lobes of peritoneal cells, one of which is posterior and one anterior. The posterior one surrounds the spur, upon the anterior one, which is the smallest, rests the two folds. The narrow duct is not unusually narrow, while the wide duct or outlet duct is very narrow, not any wider than the narrow duct. The neck of the anterior fold is, where it connects with the narrow duct, very wide, enlarged, irregular and sigmoid, gradually increasing in size to the anterior fold. Where the two folds join, the fold is always very coiled. The tube forming the bridge is not any wider than the clear canals, but it is less clear or transparent, just as in Lumbricus. The canal leading from this bridge into the anterior fold, is straighter, darker, and slightly wider than the two bright tubes which are much coiled and situated more anteriorly and superiorly to the straighter canal. This coiling ceases as soon as the big bend and windings are passed and the posterior fold is reached.

The nephrostome is large. The marginal cells in the rosette are only slightly decreasing in size toward the extremities or centripetal marginals. There is a large centripetal protuberance surrounding the inner opening of the duct, as in Lumbricus. as described by Benham, but the centrifugal cells are less regular and more scattered, The centrifugal cells are never hidden by the centripetals as in Lumbricus, and the whole centripetal protuberance is most prominent seen in whatever direction. The outlet duct enters the fold much closer to the narrow or nephrostomal duct than is usual in Oligochæta, in fact it connects with the free neck of the anterior fold, close behind the septum.

The relationship of *Pontodrilus Michaelseni* to the other species of the genus is not as clear as we might wish. Beddard's description and notes in his paper, "V. Some new or little known Oligochæta," are the only comparative remarks yet made on the few worms which are grouped under this genus, an arrangement which must be considered as entirely preliminary. The only very characteristic features which connect the six species of the genus is the commencement of the nephridia posterior to somite xii, and the opening of the spermduct into the prostate, absence of typhlosole, grape-like sperm-sacs, and no penial setæ. None of these species have been sufficiently described, an unavoidable fault attendant all species immersed in alcohol without previous careful preparation and evacuation. In the following table I have endeavored to compile the characters of the various species as far as I can make out from the descriptions, no specimens for comparison being in my possession. I include here, as suggested by Beddard, the genus *Photodrilus* Giard. I have had no access to Grube's description of *P. littoralis*, and have therefore excluded it from this table.

SPECIES OF PONTODRILUS AND PHOTODRILUS.

	P. Michaelseni n. sp.	*P. arenæ* Fr. Müller & Michaelsen.	*P. hesperidum* Bedd.	*P. insularis* Rosa.	*P. Marionis* Perrier.	*P. phosphoreus* Dugés.
Nephridia commence in somite...........	xiii.	xiii.	xiii ?	xiii.	xv.	xiv.
Nephropores in line with seta.	2.	?	?	4.	2.	2.
Gizzard..............	Rudimentary.	Absent.	Absent.	Rudimentary.	Rudimentary?	Absent.
Œsophageal swellings..	None.	None.	None.	None.	None.	Four in x-xiii.
Glandular crop.......	Large in xiv, xv, xvi.	None.	None.	None.	Present.	None.
Septal glands.........	In v to ix.	?	None.	None.	Present.	In v-ix.
Penial setæ	Absent.	Absent ?	Absent.	Absent.	Absent.	In xviii and xii
Common setæ.	Plain, regular.	Ornamented, regular.	Plain, regular.	Plain, irregular behind.	Plain, regular.	Plain, regular.
Spermatheca..........	Two pair in viii and ix; one diverticle.	Two pair in viii and ix; one diverticle.	Two pair in viii and ix; one diverticle.	Two pair in viii and ix; no diverticle.	Two pair in viii and ix; one diverticle.	One pair in ix; one diverticle.
Sperm-sacs...........	Two pair, grape-like, in xi and xii.	Two pair, grape-like, in xi and xii.	Two pair, racemose, in xi and xii.	Two pair, grape-like, in xi and xii.	Two pair in xi and xii.	Two pair in xi and xii.
Clitellum.	xiii-xviii, incomplete.	xiii-xvii, incomplete.	?	?	xiii to xvii complete (?).	xiii-xvii ?
Prostomium	Encroaches on somite 1.	Encroaches ½ on somite 1.	?	Does not encroach on somite 1.	Encroaches on somite 1.	Does not encroach on somite 1.
Ventral papillæ.......		In xvii and xix			One central, xix-xx, and one ditto, xx-xi.	
Habitat........	Guaymas, Mexico.	Desterro, Brasil.	Jamaica.	Aru Island.	Marseilles.	France.

In the above table I have principally followed Beddard, but I cannot agree with his opinion as regards the identity of Grube's *P. littoralis*, with that of *P. Marionis* of Perrier. As Perrier remarks, the ventral median papillæ described by him in *P. Marionis* are not found in *P. littoralis*, in which species these papillæ were paired. Until Grube's species has been found and redescribed we must therefore accept it as a separate one. It is of course not by any means impossible that one or more species of Pontodrilus are to be found in the same locality.

In reference to the gizzard I have given it as rudimentary in two species. This refers only to an anterior gizzard close behind the pharynx, in which the muscular layer of the œsophagus is simply thickened as shown in fig. 46 A and B. Beddard says that *P. littoralis* Grube has also a rudimentary gizzard, but I think that he judges by M. Perrier's description of what I call a glandular crop in the somites posterior to the testes. It may not be impossible that the muscular thickening of the œsophagus really exists in all the species more or less prominently, as it is easily overlooked.

That the glandular crop really exists in *P. Marionis* is evident from Perrier's drawing (fig. 22, pl. xvi), though I cannot accept the epithelial nature of the cells. Perrier says nothing of the place from which this drawing is taken, but I suspect that it was from a section of the intestine between the tubular and sacculated parts, similar as in *P. Michaelseni.*

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Eclipidrilus frigidus Eisen.

Through the kindness of a friend traveling in Sierra Nevada I have received a small number of specimens of this interesting oligochæta, but unfortunately all the specimens were in a poor state of preservation and much macerated. However I was enabled to make several very nearly continuous series of sections and thus settle several very important points in the anatomy of this worm. My former study of the species was entirely dependent on dissection, which could not possibly reveal all the details of this minute species, especially as regards the spermducts, the presence of which I am now able to demonstrate. My present researches show that the species is less erratic in its anatomy than I first supposed, while again in many respects it differs strangely from its nearest allies, the various genera of Lumbriculidæ. For the present I retain the family of Eclipidrilidæ, but not on the same grounds as formerly, and I now consider it rather as a subfamily to Lumbriculidæ than one standing isolated, however with strong leaning towards Moniligaster.

The generative organs are situated as follows:

Testes, two pair. The anterior pair attached to the anterior septum of somite ix. The posterior pair similarly to the anterior septum in somite x.

Ovary, one pair attached to the anterior septum of somite xi.

Oviduct in xii, opening in front of the inner pair of setæ.

Spermathecæ, one pair in ix opening posterior to the setæ and near the posterior septum.

Atrium and *prostate*, one pair opening in x, posterior to the inner pair of setæ. This organ, which is very long, occupying seven to eight somites, consists of three parts, first, one anterior atrium and prostate proper, second, a thin and narrow part connecting the former with, third, the posterior one, a storage chamber for spermatozoa.

Spermducts are two pairs, exceedingly narrow, opening close together in the posterior part of the storage chamber.

Ciliated rosettes, two pairs, the anterior pair opening in ix. The posterior pair in x, both in front of the septum. They are exceedingly thin and flat. The posterior wall is attached to the septum.

Sperm-sacs consist of a pair of very long continuous sacs, which cover the generative organs, including the spermatheca, and extending from somites x to xvii or xviii, generally several somites posterior to the caudal part of the storage chamber.

Setæ are 8 in 4 pairs in each somite, commencing with the second.

The *vascular system* is characterized by blind forked vessels in the posterior 30 odd somites, thus bringing the genus in close relationship with Lumbriculidæ. Another characteristic is the two loops of lateral vessels which branch out from the main vascular trunks in somites ix and x, and which run backwards as far as the end of the storage chamber. The anterior eight somites contain winding lateral vessels connecting the two main dorsal and ventral trunks. Hertzkörper in the dorsal vessel as well as in the branches in the intestine. After these preliminary references to the main anatomical points I will enter more fully upon the anatomical and histological structure of the various organs.

Body-wall and Clitellum. The finer structure must be left for future study. The inner longitudinal muscular layer is considerably thicker than the transverse layer and hypodermis together. The longitudinal strands are very thin and ribbon-like, some being much longer than others and reaching through the width of the layer, others being very much smaller, situated principally close to the transverse layer. Figs. 77, 79, 99, etc.

The clitellum comprises about 6 somites, commencing in the posterior part of ix and extending to the center or posterior part of xiv. The clitellar glandular cells, one layer thick, are oblong, irregular, flask-like, containing very coarse, angular, grains (fig. 79). They are separated or interspersed by large non-staining cells. The peritoneum is rather poor in blood vessels, but the layer is very thick, in places almost as thick as the longitudinal muscular layer (fig. 82, *pr*).

Septa. None of the septa are abnormally thickened. The first distinct septum is seen between somites v and vi. The septa are straight, not cup-shaped. Those surrounding the various divisions of the prostate are much firmer than the others. They constrict the prostate, in fact the latter appears notched at every septum (figs. 78, 92, 94).

Alimentary canal. The alimentary canal can properly be only divided in two parts—pharynx and intestine. The pharynx which ends in somite v is developed latterally and dorsally, but not ventrally (figs. 83, 77). The thickened part is very thick, consisting of the usual narrow and almost filiform cells. The ventral part is very thin, thinner in fact than any other part of the alimentary canal. Of the balance of this canal there is no distinction between œsophagus and sacculated intestine. The gut is every where sacculated, only increasing in thickness towards the genital somites, where it is thickest. The alimentary canal throughout its length is lined by a columnar, ciliated epithelium, outside of which is a very thick vascular layer, with large blood lacunes, directly connected with the dorsal and ventral vessels, which are closely attached to, or almost imbedded in the intestine. The latter as well as the vessels are covered with chloragogic cells, which, especially in the region of the dorsal vessel, are very large (figs. 85 to 91), the layer being thickest close to the strands of mesenteric tissue connecting the intestine with body-wall.

The free cœlomic lateral vessels in the eight anterior somites are similarly surrounded by a thick mass of glandular cells, arranged around muscular strands, and which are quite distinct from the chloragogic cells and more resemble real glands. Their reaction to stains is entirely distinct from that of the chloragogic cells of the main vessels and of the alimentary canal, staining very deeply with ammoniated hæmatoxylon (fig. 84), and showing a coarser grainy secretion, while the real chloragogic cells remain much more pellucid and contain much finer grains. Cells similar to the former are also seen attached to the cœlomic covering of the prostate (fig. 107, etc.) They also greatly resemble the glandular cells, or multicellular glands from the pharynx of Pontodrilus and other oligochæta, possessing pharyngeal glands.

The vascular layer of the intestine is very much developed, especially on the ventral side, where it connects with the ventral vessel, through a thick band of mesenteric and connective tissue. This as well as the walls of the blood vessels were so thickly studded with a protozoa (Hæmagregarina) that the structure of the layer could not even in a single instance be properly made out.

There are no pharyngeal glands, though a few glandular cells are seen scattered about between the muscular strands connnecting the pharynx with the body-wall. But these cells resemble more chloragogen cells than true pharyngeal glands.

The *testes* are of no unusual structure. The anterior pair, in the specimens I opened, are smaller than the posterior pair, which were always forked, while the anterior pair was undivided.

The *ovary* in xi is always sigmoid of irregular shape and present the peculiarity that seldom more than one ovum is developed at a time, this one being situated not at the periphery or at the free end of the ovary, but in the inner angle of the sinus. The ovum is unusually small in size and readily detached from the gonad (figs. 78, 108). It grows large after separation, and is found in numbers in the posterior somites.

The *ovary* is of large size reaching far back to the posterior septum. Its lower end is not only attached to the septum and body-wall, but also to the narrow end of the outer sperm funnel (or ciliated rosette) fig. 96. In one of the specimens sectioned the ovaries either extended past the oviduct through somite xii, or there was a second pair of ovaries in xii. Beddard has similarly remarked that the ovary in Sutroa is attached to the cells of the spermiducal funnel.

Spermatheca. As stated there is one pair situated in ix, the spermathecal pore being posterior to the setæ, and in line with the inner couples. The spermatheca consists of two distinct parts, as is usual in this group, the lower muscular part, and an upper rounded part consisting of an unicellular layer of dice-shaped cells. This rounded chamber was sometimes situated in the same somite, ix, as the muscular body, but frequently it projected backwards into somite x.

The structure of this muscular part is represented in figure 82. The inner epithelial layer, consists of narrow columnar cells, with rounded nuclei and striated protoplasm. Exterior to this layer, there is a thin one of transverse or circular muscles, outside of which again is an epithelial stratum one or two cells deep, with slightly oblong nuclei, the cells themselves being irregularly dice-shaped (fig. 82).

Prostate and spermducts. The most interesting, as well as the most complicated structure of this species, is the prostate, of which I am now able to give a fuller account, which I believe will not leave any of the points of its structure in doubt.

I have already referred to the three main divisions of the organ, the proximal one consisting of a long cylindrical tube, containing penis, atrium and prostate. Second, a very narrow tube of almost the same structure as the prostate part of the former, connecting with a long cylindrical chamber of somewhat modified structure, into which the two spermducts open, quite near its junction with the narrow part or bridge. If we, however, disregard the difference in size of these various parts and only consider the structure, we find that the whole organ may also be divided in three parts:

First, the proximal part, which is entirely confined to somite x. This part is upright, so to say, does not run backwards; it is also somewhat bent, forming a right angle with the balance of the organ. This part consists of penis, and a long tubular part which, in want of a better name, I designate as atrium (fig. 100 *atr.* and *p.*). With somite xi commences a change of structure of this organ, common both to the wide part and to the very narrow posterior part. I will refer to it as the prostate proper, as it contains the thick layer of regular prostate cells so common in all higher oligochæta where this organ occurs; it is the "two layer"—prostate of Beddard. The third part or storage chamber is characterized by the absence of this layer.

I will now refer to each one of these three or four parts in succession and more in detail, beginning with the penis and atrium.

Next to the body-wall, ending at the transverse muscular layer and from there stretching inwards, is a reversible sac—a preputium—consisting of epithelial cells, with very large, round, compressed nuclei and striated contents. This epithelium is surrounded by a thin muscular layer (fig. 100, *pre.*, 101).

Into this preputium opens a penial glans (fig. 100 *p. gls.*, 101, etc.), consisting of two separate covers, posteriorly attached to a collar of larger rounded or pear-shaped cells, at the base of which are seen a number of muscular plates. This collar is folded on itself, one part of the fold connecting with outer and one part with the inner cover of the glans. Through the median line of these parts runs a long, very narrow excretory tube with thick walls. Nearest the male pore this tube is quite straight, or only slightly folded, but at its distal end the windings are greatly packed or irregularly coiled (fig. 99, *tube*).

The part posterior to the penial collar I have designated the atrium proper, simply because it does not contain any inner layer of glandular cells, and because in its distal end it connects with the true prostate. The excretory tube continues all through this part and is, so to say, suspended in a more or less dense mass of fibrous tissue. Nearer the collar this mass is reduced to a few strands only, but towards the distal end it becomes quite dense, especially so nearest the tube, while towards the periphery it is much less dense (fig. 92, *f. t.*, fibrous tissue; *f. st.*, fibrous strands). Fig. 100 represents a cross-section taken near the distal end; the tube is seen coiled in the center, while fibrous tissue connects it with the walls of the atrium.

The exterior layers of the atrium are constructed very much as the same layers of the prostate proper and the storage chamber. There are three layers which are common to the two different parts of the prostate. Interiorly a thin layer of circular muscles somewhat variable in thickness in different parts, but generally only three or four strands thick. Exterior to this layer runs a spirally wound layer of longitudinal muscles, arranged in band-like plates, and when seen in cross-section resembling a row of fringes (figs. 100, 101, 102, 103, 106, 107, *l. m*). Fig. 107 shows these plates, highly magnified, to consist of rather rectangular muscular strands. Exterior to this layer of *l. m.* muscles we find everywhere a broken row of prostate glands of very minute size, appearing to penetrate in between the muscular plates, though on account of the macerated condition of the tissues I could not follow their tubes. These small glands, which barely project outside of the muscles, are found everywhere from the distal end of the storage chamber to the penial collar, wherever this muscular layer is found. In places they are continuous, in others scattered about, seldom more than one row thick (fig. 101, *gls*). But as we reach the region of the narrow part of the prostate and especially the part of the storage chamber where the spermducts enter, we find another thicker layer of prostate glands similarly scattered over the longitudinal muscular fringe (figs. 102, 103, 106, 107, *pr. gl. s*, small prostate glands; *pr. gl. l.*, large prostate glands). In the region where the spermducts enter the storage chamber this layer of large prostate cells is almost continuous and considerably thicker than the muscular layers combined (fig. 103).

The prostate proper contains besides these layers of muscles and exterior prostate glands two inner layers, which resemble and propably correspond to the two cell-layers found in the prostate of the higher oligochæta, viz.: one layer of lining epithelium (fig. 101) and one layer of glandular prostate cells, with very large nuclei, and separated one from the other by transparent spaces, through which possibly enter projections of the exterior prostate glands. These two characteristic layers do not extend to the narrowest part of the prostate. Hence the muscular layer is covered by a single row of inner lining epithelium with large, slightly oblong nuclei (fig. 102), which in the very narrowest part are about 12 to 14 in the row.

The proximal end of the storage chamber is lined by a very thick epithelium with very oblong nuclei (fig. 105 *ep.*). This epithelium is thickened only at the anterior side, nearest the narrow tube (fig. 104), but narrows quickly both superiorly and posteriorly. The inner transverse muscular layer is similarly thickened in this region (fig. 105, *t. in.*).

The storage chamber contains the same general layers as the narrow bridge. The inner lining epithelium is narrow, with very compressed nuclei, with the flat side lying against the muscular wall (fig. 107).

The nature of the prostate differs apparently much from that of the prostates of some members of Lumbriculidæ, especially Sutroa, as lately more minutely described by Beddard, but more resembles in structure Lumbriculus. But I am more inclined to compare its makeup with the prostate of Moniligaster. In Eclipidrilus the prostate contains the characteristics of both Limicolæ and Tericolæ, if I may yet use the expression. The inner two-celled layer of the prostate which is characterizing most higher earth worms, possessing a prostate, is superposed by the layers, muscular and glandular which characterize Tubifex, Moniligaster, etc.

Spermducts. I am now able to describe the spermducts for the first time. They enter the storage chamber of the prostate near to the bridge and close together, but still entirely separate (fig. 95), and when the inner surface of the chamber is viewed from above the entrance pores are seen as two small slightly elevated papillæ (fig. 95 *sp.*) From these the spermducts, which are of very minute size, run forward parallel to the prostate, one on either side, except alongside of the bridge where they run close together. The outer pair leave the prostate in xi, dip down to the ovaries in which they are partially engaged and push their ciliated rosettes through septum x/xi, the rosettes opening in x. The inner spermducts are similarly engaged in the gonads in x, push through septum ix/x and open their rosettes in ix, all very close to the body-wall.

The rosettes are only one cell thick, very thin and flat, with the posterior surface attached to the septum, the anterior lip only being free. Only the inner deeper surface of the rosettes is ciliated.

Sperm-sacs, one on each side and continuous from the beginning of the spermatheca, reach as far back or further than the posterior end of the storage chamber of the prostate. Generally the sperm-sacs reach two or three somites further back. Each sac is separate from the other and consists of one continuous bag contracted somewhat at the septa. It is not racemose and does not connect with the septa as in so many of the higher forms, but greatly resembles those of Sutroa. The sperm-sac only covers the prostate, but does not properly enclose it, as it does not extend to the space between the prostate and the intestine. With the latter, however, it is connected by two continuous walls of connective tissue, one on the dorsal and one on the ventral side of the intestine. In the enclosure thus formed the prostate, as well as the upper part of the spermatheca, lies free.

In the posterior parts of the sperm-sacs are always seen very large sacs of yolk granules. In one specimen I found a mass of these yolk granules surrounding the spermatozoa in the prostate storage chamber (figs. 120 to 123). The yolk sacs are frequently so large that they fill the larger part of the cœlomic cavity pressing the intestine close up against the wall of body.

Nephridia. The most anterior nephrostome is found in iii in front of septum iii/iv. The most anterior nephropore is found in iv in front of the inner couple of setæ. There are nephridia (pores) in iv, v, vi, vii and viii, while somites x, xi, xii have no nephridia. The neck of the nephrostome contains a large glandular swelling, to which is attached muscles connecting with the septum. This neck is perforated by several narrow ductules, which occasionally branch. The duct appears to consist of a single tube not covered by peritoneal glands. On account of the rather macerated condition of the specimens I could not investigate the nepridial structure any closer.

Some of the specimens collected by my friend were from a new locality and somewhat larger in size. This locality is Three Spring Meadow, on the east side of the North Fork of Kings River, opposite the natural bridge, at an altitude of about 8,000 or 9,000 feet, and several thousand feet above the river bottom at that point. They were there found under some old logs lying across the meadow, and over which the water was flowing, the worms being attached to the surface of the decayed wood. These specimens were about ⅓ larger than those from the springs at Alpine Meadows on the South Fork of Kings River several thousand feet higher up, but I find no distinct characteristics, though the spermatheca appeared more twisted. Among the specimens were a few of *Telmatodrilus Vejdovskyi,* for which I am thus able to note a new locality.

PLATE XXX.

PLATE XXX.

PHŒNICODRILUS TASTE.

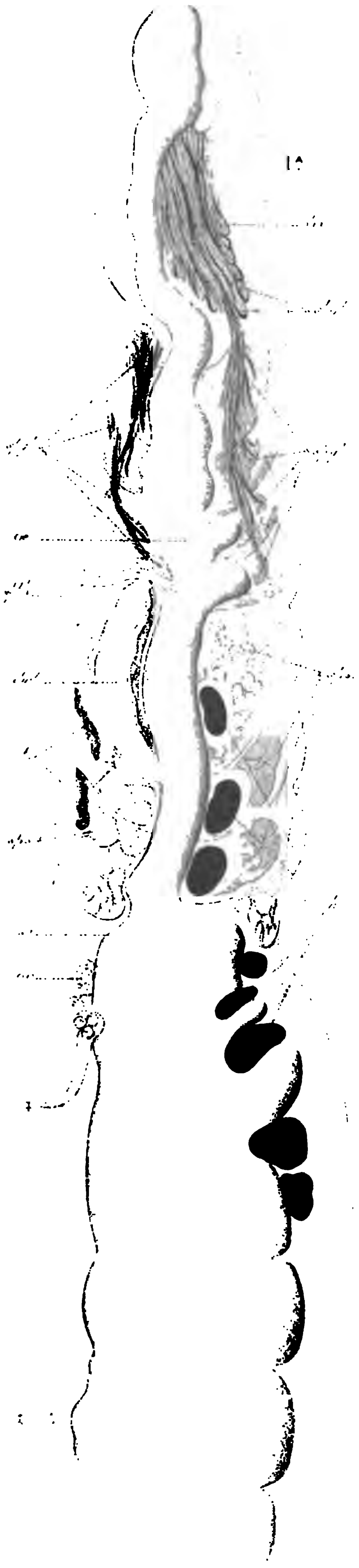
1A. Semi-diagrammatic view of the body in a longitudinal vertical section, showing the position and proportion of the various organs. *phx.* pharynx. *sl. gl.* salivary glands. *sp.gl.* septal glands. *sp. s.* sperm-sacs. *cl.* clitellum. *h.* hearts and dorsal vessel. *œ.* œsophagus. *spth.* spermatheca. *divt.* diverticulum of œsophagus. *t.* testes. *si.* sacculated intestine. ♀. ovipore. *ov.* ovary. ♂ male pore.

1B. View of the interior organs, the body-wall being laid open from above. On the right hand side the sperm-sacs have been removed in order to show the underlying organs. The letters indicate the same as in figure one. The shaded part of somites xiv to xviii indicate the clitellum proper. *ac.* accessory copulatory papillæ around the outer setæ in somite xiv.

2. Longitudinal section through some of the anterior somites, from a section lateral to the œsophagus, illustrating the connection between the septal and supra œsophagal glands and their ducts, which all open into the upper wall of the pharynx. *s.* septum. *bd. w.* body-wall. *sl. gl.* salivary or supra pharyngeal glands. *s. gl.* septal glands.

3. Spermatheca in outline.

4. The spermduct and male pore viewed from above or from the interior of the body. Both are covered by the longitudinal muscles, as well as by numerous arciform muscles.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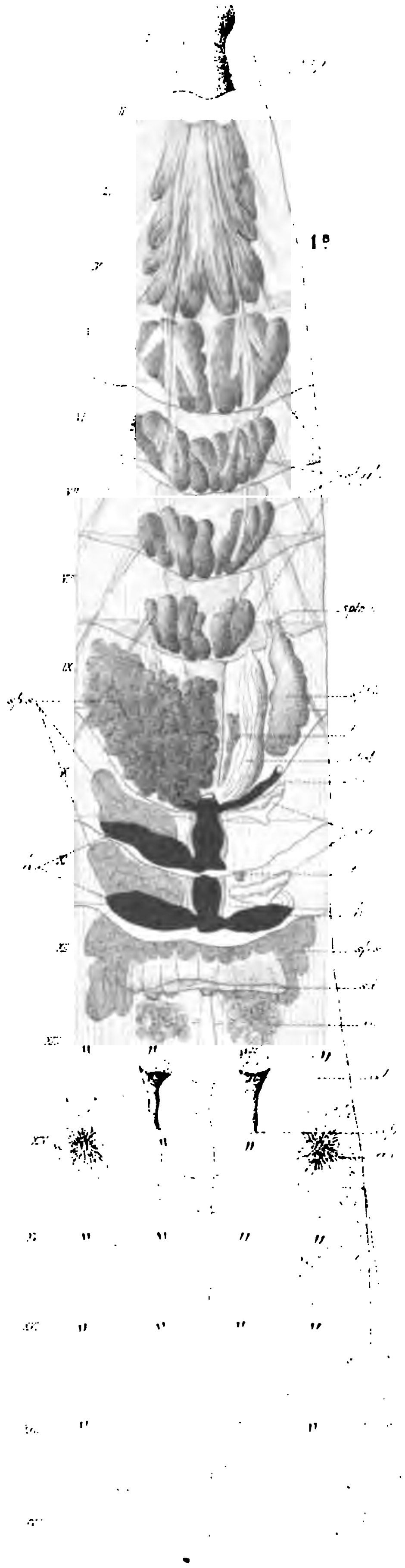
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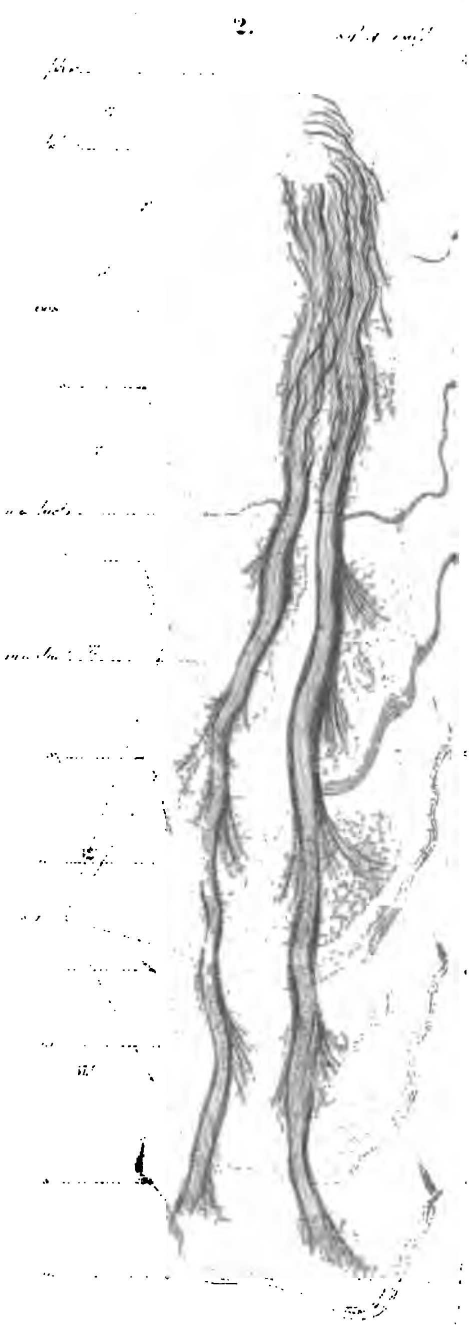
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PLATE XXXI

PLATE XXXI.

PHŒNICODRILUS TASTE.

5. A transverse section of the body-wall in somite xvii, through the male pore showing the degenerated atrium and the wider upper part where enters the spermduct. These latter have just been fused and enter the pore as one single duct. *cl.* clitellar cells. *hy.* hypodermal layer. *cl.* collar of epithelium of the atrial chamber. *ac. m.* arciform muscles. *f. sp.* fused spermduct just entering the atrial chamber. *l. m.* longitudinal muscular layer of body-wall. *tr. m.* transverse muscular layer of body-wall. ♂ male pore.

6A. The section nearest anterior to the former, showing the spermducts just as they enter the atrial chamber. The spermducts are not yet fused. Figures indicate the same as in the preceding figure. *sp.* spermducts just before being fused together.

6B. Section nearest anterior to the former showing the two spermducts, etc.

7. The three somites xvi, xvii and xviii viewed from the interior, the alimentary canal and nerve-cord having been removed, as well as nephridia.

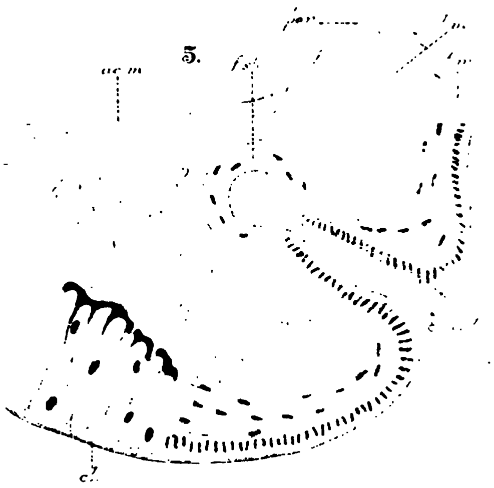
8. One of the setæ magnified, the same relative proportion as that used in my paper on Ocnerodrilus.

9A. One of the nephrostomes seen in front views. When in proper position the face of the rosette stands parallel to the septum. *r.* rosette proper. *n.* neck with very large glandular cells. *n. d.* narrow duct. *s.* septum. *f.* fold of the main nephridial body.

9B. Nephrostome seen from the side, the position when the body is opened and spread out. Letters indicate the same as in the last figure.

10. One of the muscles connecting septal glands with body-wall, in cross-section. *s.* septum. *m.* muscular fascicle.

11. One of the posterior nephridia seen under a low magnifying power in order to show the peritoneal covering and the general outline of the canals in the lower peritoneal lobe. *a. f.* anterior fold of canals. *p. f.* posterior fold of canals. *spu.* the partially free spur. *s.* septum. *nst.* nephrostome. *np.* nephropore. *w. t.* the wide tube leading to the nephropore. *br.* bridge connecting the spur with one of the folds. *u. l.* upper lobe of peritoneal cells which does not contain any canals. *c. l.* connecting lobe. *l. l.* lower lobe. The two peritoneal lobes vary greatly in shape and hardly two are found exactly alike, though the general form is the same in all.



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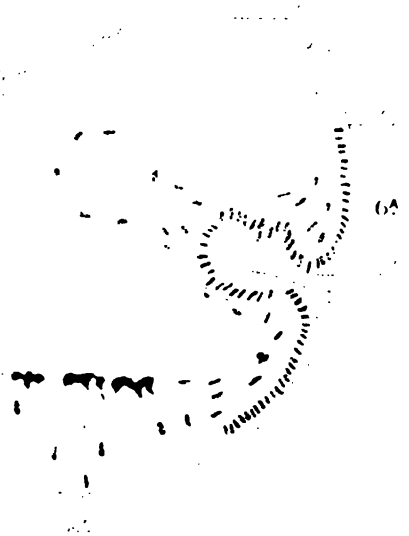

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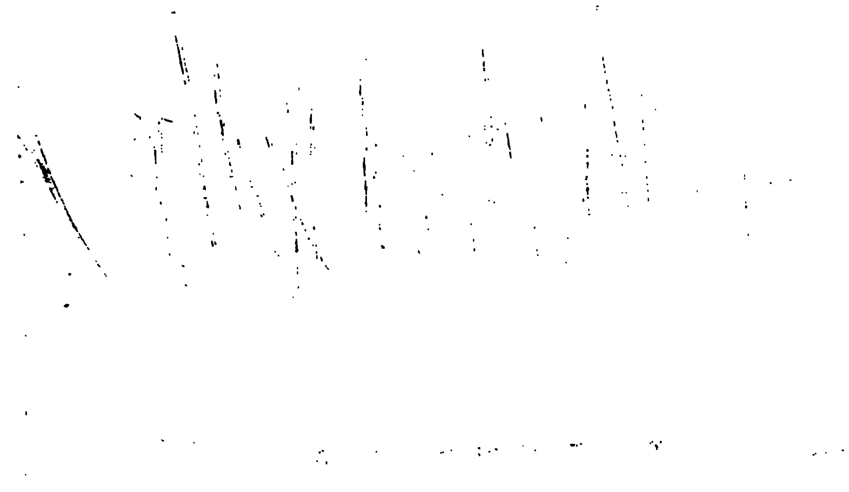

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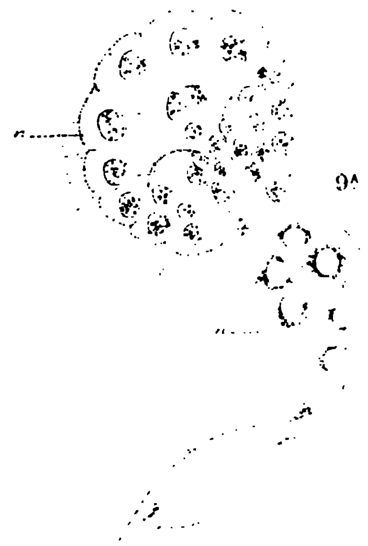

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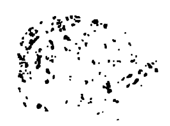

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PLATE XXXII.

PLATE XXXII.

PHŒNICODRILUS TASTE.

12. One of the posterior nephridia more highly magnified, to show the course of the canals.

13. Phœnicodrilus taste, natural size, the worm having first been killed gradually with increasing strength of alcohol. Largest specimen.

14. Section of the intestine at the point of connection with the diverticula, in order to show the arrangement of the blood vessels and the subdivisions of the diverticula. This figure is taken at the junction and shows the diverticulum as one chambered, and with a large blood vessel penetrating the diverticulum from the outside. This blood vessel comes from the dorsal vessel. This and the following five figures are outline drawings from slides, but the details of less importance are not filled in. *bl.* small vessels in the vascular layer of the alimentary canal. *dv.* diverticulum. *bl. v.* large blood vessel penetrating the diverticulum from the exterior. *ep.* epithelial lining of the intestine. *m. l.* muscular layer of the intestine.

15. Section closely following, or anterior to the former, showing the diverticulum as one chambered and with a division of the blood vessels into smaller ones. Letters indicate the same as in the former figure.

16A. A section of one of the diverticula a little anterior to the former, the organ is yet one chambered, and a large blood vessel is seen on the left side or the side nearest the intestine. *l. bl. v.* very large vessel. *bl. v.* small vessels in the wall of the diverticulum.

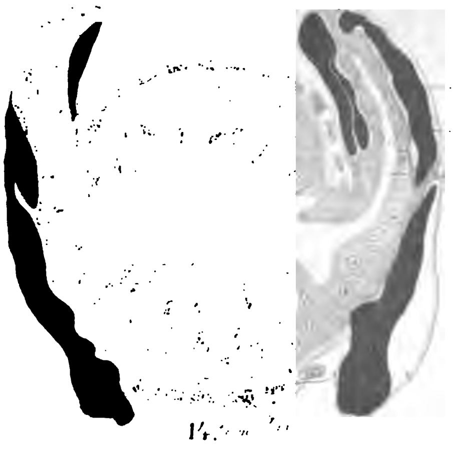
16B. A section anterior to the former, showing the beginning of the subdivision of the diverticulum.

16C. A section next anterior to the former, showing the diverticulum two chambered.

16D. A section near the center of the diverticulum, showing six interior chambered and a multitude of blood vessels.

16E. A part of diverticulum more highly magnified, showing nuclei and striated cycloplasm.

16F. Section of alimentary canal.



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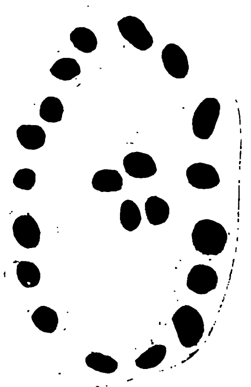

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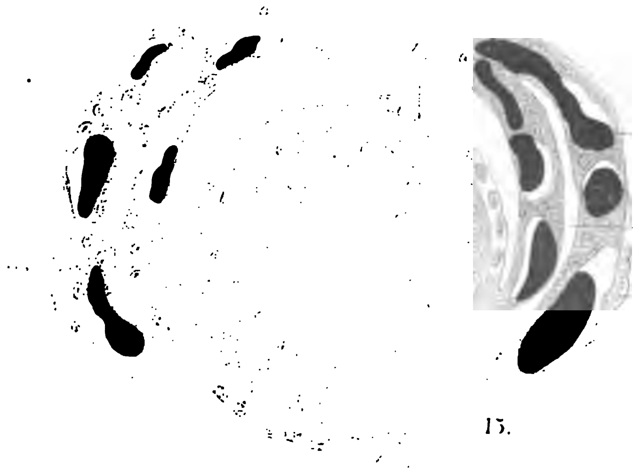

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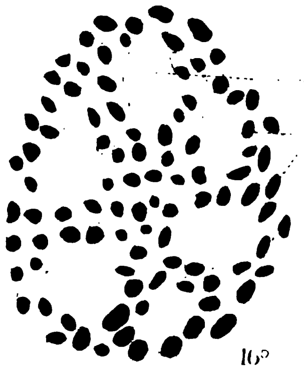

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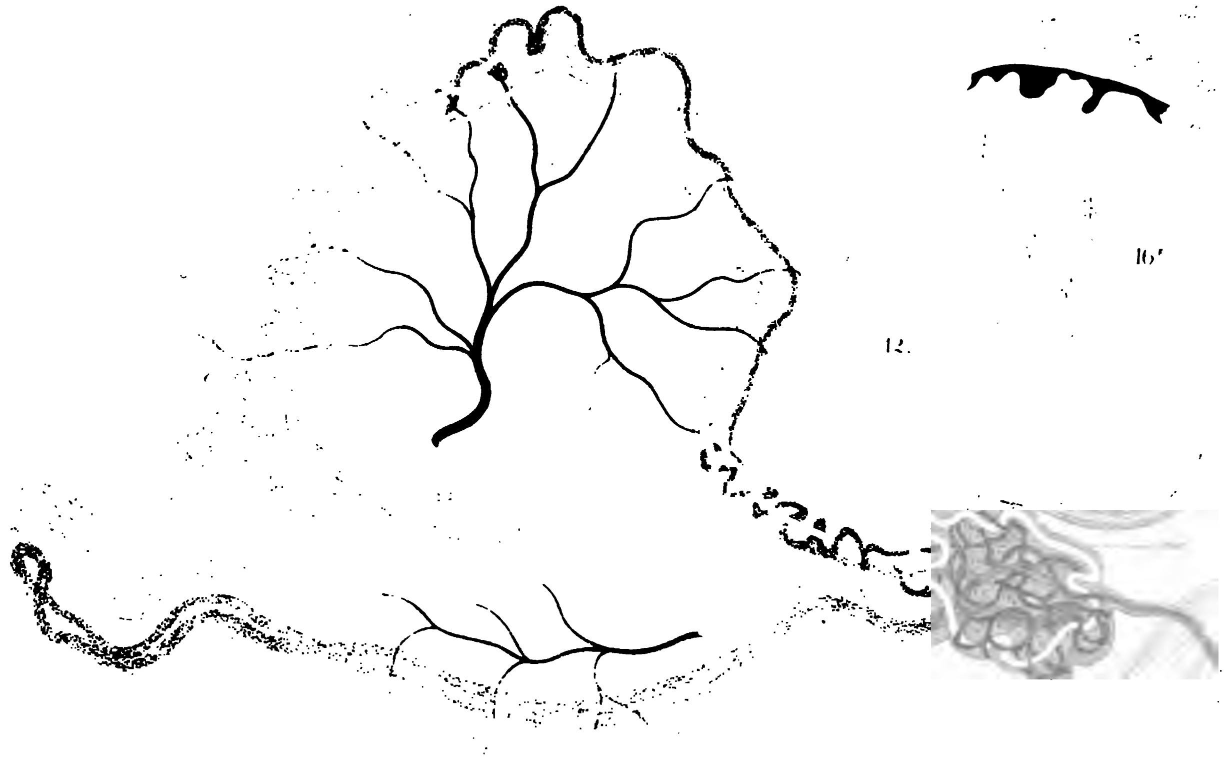

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PLATE XXXIII.

PLATE XXXIII.

PHŒNICODRILUS TASTE.

17. Longitudinal section of the alimentary canal (œsophagus), in vi. *ep.* inner lining epithelium. *gl.* glandular cells. *bl.* blood sinus. *m.* the two muscular layers. *pt.* peritoneal epithelium.

18. Longitudinal section of the pharynx, showing the glandular ducts and ductules penetrating the pharyngeal epithelium. *cl.* ciliated surface. *n. ep.* nuclei of epithelium. *dus.* ductules. *duct.* large duct from the pharyngeal glands above the œsophagus. *œ. ep.* œsophageal epithelium joining the pharyngeal ciliated epithelium.

19. Section of the body through one of the clitellar somites, a diagrammatic view, to show the relative size of the different layers of the body-wall. *d. v.* dorsal vessel. *s. i.* saculated intestine. *m. l.* the muscular layers. *cl. c.* clitellar cells. *sp. d.* spermducts. *v. v* and *n. c.* ventral vessel and nerve cord.

20. A diagrammatic section of the body in somite ix showing the relative size, etc., of the diverticula and the layers of the body-wall. *d. v.* dorsal vessel. *sp. s.* sperm-sacs in somites ix and x. *div.* diverticula of the intestine. *v. v.* ventral vessel. *n. c.* nerve cord.

21. Section of body-wall of a non-clitellar somite. *g. c.* unicellular glands. *s. c.* supporting cells. *t. m.* transverse muscular layer. *l. m.* longitudinal muscular layer. *pr.* peritoneum.

KERRIA McDONALDI.

23. Nephridium of *Kerria McDonaldi* from one of the somites closely posterior to the clitellum. *pr. s.* peritoneal sac with nuclei. The posterior end of this sac is not furnished with blood capillaries. *c. bl.* capillary blood vessels, spreading principally through the peritoneal sac. *a. l.* anterior lobe. *p. l.* posterior lobe. *nephr. st.* nephrostome. *nephr. pr.* nephropore. *w. d.* wide duct outlet. *n. d.* narrow duct. *nec.* neck of the nephridium. *br.* bridge. *spr.* spur. *s.* septum.

PONTODRILUS MICHAELSENI.

24. A specimen, natural size, having been slowly killed and extended. One of the largest specimens, the majority being only one-half as large.

25. The three anterior somites seen from the side. *pr.* prostomium. *per.* peristomium.

26. The anterior part of the worm more highly magnified, ventral view. *cl.* clitellum. ♂ male pore. *spth. p.* spermathecal pores. *ov. p.* ovipore. *c. pr. m.* cushion where ends the fan-shaped fascicle of prostate or arciform muscles. *c. c.* exterior copulatory cushion.

27. Part of the body-wall laid open and spread out to show the relative distances of the setæ, the numerals indicating the number of the seta. The ventral nerve cord is indicated.

28. One of the setæ highly magnified.

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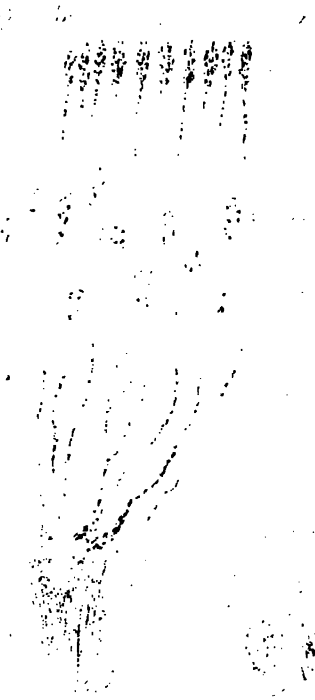

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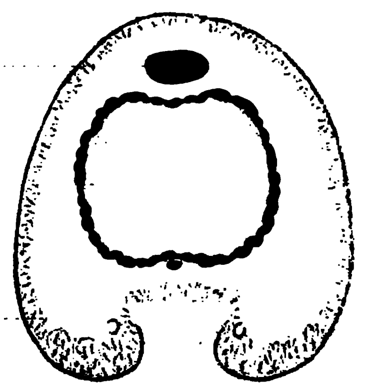

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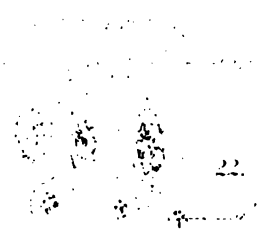

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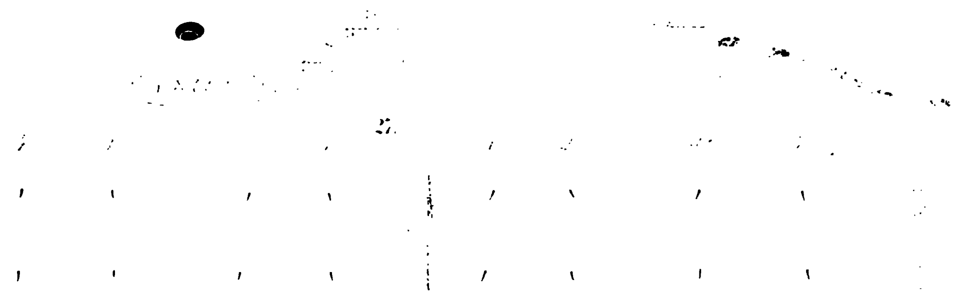

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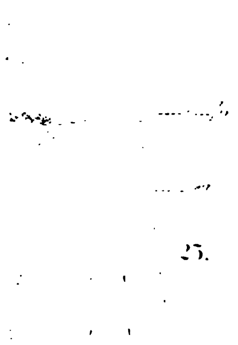

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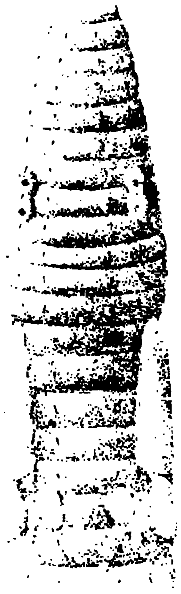

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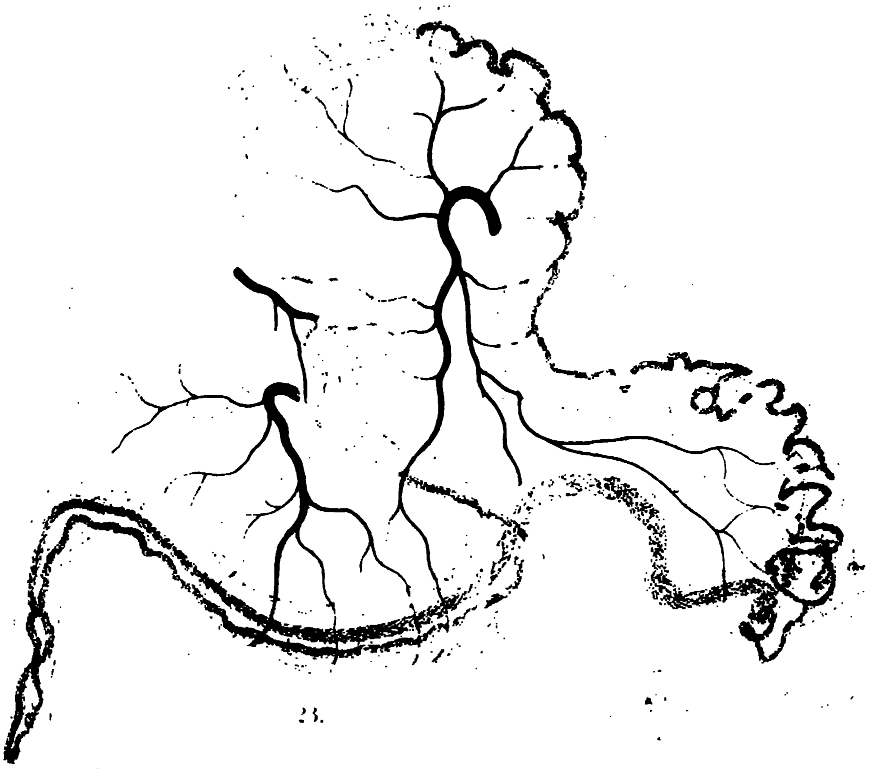

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PLATE XXXIV.

PLATE XXXIV.

PONTODRILUS MICHAELSENI.

29. A somewhat diagrammatic view of the anterior somites seen in longitudinal section. *br.* brain. *mo.* mouth. *ph.c.* pharyngeal cavity. *phx.* pharynx. *m.* muscular strand connecting pharynx with the body-wall. *sl. gl.* salivary or pharyngeal glands opening by ducts in the pharynx, the ducts being supported by muscular strands (stained yellow). *ss. gl.* smaller gland; connected with blood vessel. *gl.* glands connected with the lateral vessels. *œ.* œsophagus. *d. v.* dorsal blood vessel. *s.* septa. *spth.* spermathecæ, and their diverticula. The lower end of the spermatheca is greatly enlarged, forming propulsory bursa. *spth. p.* spermathecal pore. *t.* testes. *ov.* ovaries. *ovd.* oviduct. *c. r.* ciliated rosettes. *h.* hearts. *sp. s.* sperm-sacs. These sacs are principally ventral to the œsophagus. *nephr.* nephridia, the most anterior one is found in somite xiii. *cl.* clitellum. *gl. cr.* glandular crop in shape resembling a gizzard. *s. i.* sacculated intestine. *pr.* prostate. *δ* the muscular duct of the prostate cut through. *c. c.* copulatory cushion. The dotted line indicates the outlines of the duct as they appear in other sections.

30. Section through the posterior part of the pharyngeal glands, showing the arrangement of the glands, ducts, muscles and blood vessels, all in vertical section. *œ.* œsophagus. *ep.* inner epithelial lining. *m. œ.* circular œsophageal muscles. *m.* muscular strands. *phx. gl.* pharyngeal gland. *d. v.* dorsal vessel.

In this figure the glands are stained violet, the muscles appear as yellow and the ducts are dark violet. The blood vessels are black ·(Corosive sublimate, abs. alcohol, orange G. amm. hæmatoxylon. Thus in xylol. This and the following five figures are all drawn from sections treated in the same way.)

31. A longitudinal section of a lobe, showing the general arrangement of the glands and ducts. *duc.* ducts from the gland, leading anteriorly to the pharynx. *gl. c.* glandular cells. *bl. gl.* blood glands. *m.* supporting muscular strands. *bl. v.* blood vessels.

32. A small glandular lobe more highly magnified. The letters indicate the same as in the preceding figure. The nuclei are stained yellowish with orange G. The secretion of the cells is precipitated? and stained dark violet with amm. hæmatoxylon.

33. A part of a gland, with supporting muscles.

34. Two sections of muscular strands, showing the connection with the ducts in which the secretion has been stained deep blue.

35. One of the glandular cells with nucleus stained yellow. The vacuoles (*va.*) are white, the protoplasm grayish, while the secretions are stained deep bluish-violet.

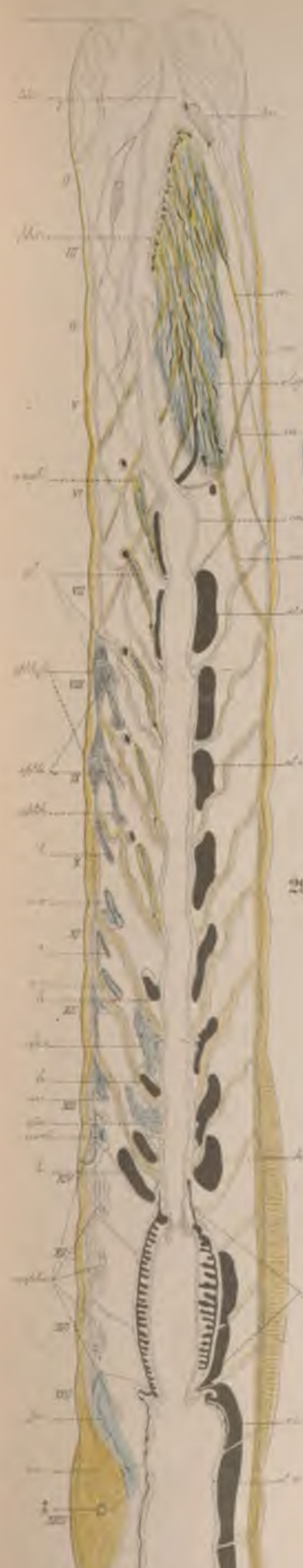
36A. The proximal end of two glandular ducts where they penetrate the epithelial lining of the pharynx, near its dorsal side, showing the ductules or end ducts leading between the epithelial cells. *bl.* blood vessels. *m. ph.* supporting muscles for the ducts connecting with pharynx. *t. m.* transversal muscles cut across. *gl. d.* glandular ducts leading from the gland at the distal end beyond the pharynx. These ducts are the largest and collective ones, having received the secretion from many smaller ducts. *ep.* epithelial cells lining the pharyngeal cavity. *gl. dt.* glandular ductules passing between the former into the pharyngeal cavity. *s. gl.* two of the smallest of the salivary glands, a few of which are found at the periphery of the pharynx.

36B. A longitudinal section of one of the small septal glands, one pair of which is found in v, vi, vii, viii, ix. *c. bl. v.* connecting blood vessel between the ventral vessel *c. bl.* vi and the dorsal vessel. This vessel is cut in two places, the one marked *c. bl.* vii being nearest to and just below the œsophagus (*œ. v.*) the ventral outline of which only is figured diagrammatically. *s.* septum, outline of, between vi/vii. *gl.* small glands, a few of which surround the somewhat larger septal gland. *s. gl.* the largest septal gland. *w. c.* wandering or perigastric corpuscles. *d. t.* discharge ducts from glands, probably connecting with the pharynx.

37. Cross-section of an immature specimen, through the intersegmental groove between somites xvii/xviii, just anterior to the copulatory cushions. In this section no clitellar cells have yet developed on the ventral side of the body. *hy.* hypodermis. *t. m.* transverse muscular layer. *l. m.* longitudinal muscular layer. *neph.* nephridium. *s. a.* septum between xvii/xviii. *m.* muscles connecting the glandular part of the spermatheca with the body-wall. *gl. pr.* glandular part of the prostate. *spd.* the sperm-duct just entering the glandular prostate. *m. pr.* muscular part of the prostate. *v. nc.* ventral nerve cord. *s. i.* sacculated intestine.

38. Cross-section of the body of an immature specimen, through somite xviii, the section passing through the copulatory cushions and through a part in which the clitellar cells on the ventral side of the body are already developed. *a. m.* arciform muscles connecting the copulatory region with the dorsal part of the body-wall. *cl. c.* clitellar cells developed in this somite only on the ventral side, never extending to the dorsal side even in fully mature specimens. Other letters indicate the same as in the preceding figure.

39. Cross-section through somite xiii close to the anterior septum. The clitellar cells are here fully developed. *s. s.* part of septum between xii/xiii. *cl. c.* clitellar cells, only developed dorsally. *v. cl.* ventral termini of the clitellar cells. *ov.* ovaries. *spd.* spermduct. *t. i.* tubular intestine. *dv.* dorsal vessel. *h.* hearts.



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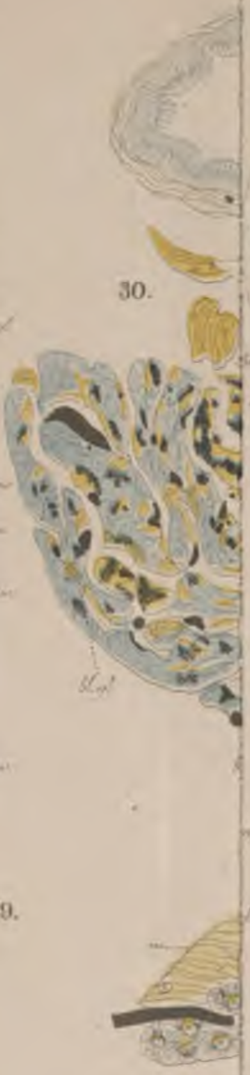

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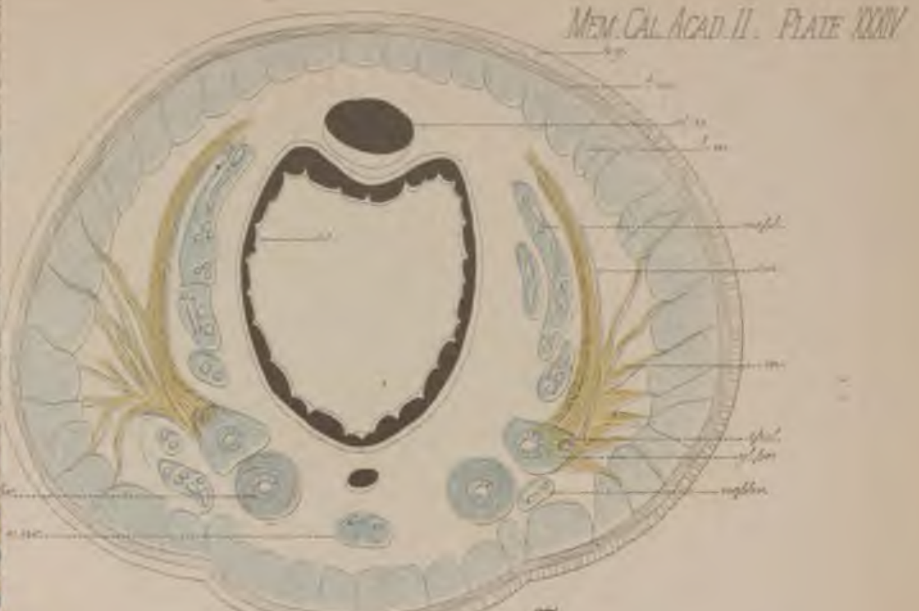

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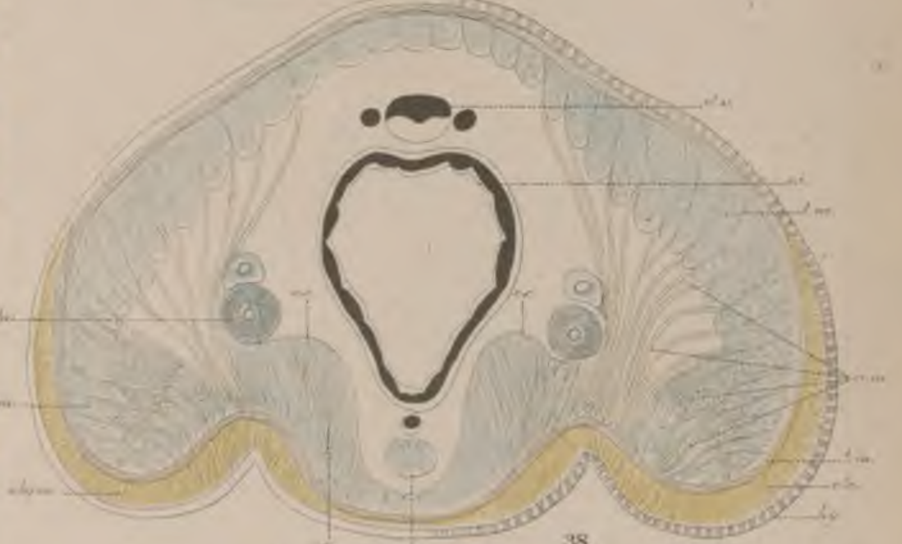

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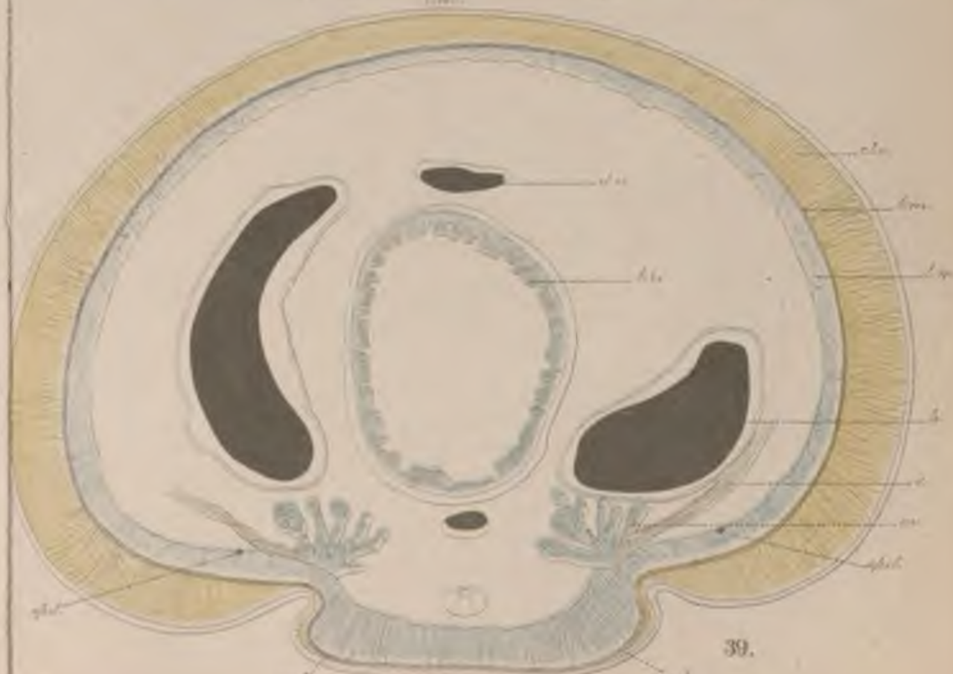

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PLATE XXXV.

PLATE XXXV.

PONTODRILUS MICHAELSENI.

40. Cross-section through somite xvii of a mature specimen showing the development of the clitellar cells on the dorsal and lateral sides of the clitellum. *v. cl.* ventral termini of the clitellar cells. *d. v.* dorsal vessel. *s. i.* sacculated intestine. *neph.* nephridium. *gl. pr.* glandular part of prostate. *pr. m.* muscular part of prostate. *m.* muscles connecting the prostate with the body-wall. *t. m.* transverse muscles. *l. m.* longitudinal muscles. *cl.* clitellar cells. *v. cl.* ventral termini of the clitellar region.

41. Cross-section through a strongly contracted, fully matured specimen, through somite xviii, showing the copulatory cushions as fully developed, as well as the clitellar cells on the ventral side. Unfortunately the only fully developed specimen at my disposal had been badly contracted, hence the cells appear smaller than they would have done in properly prepared specimens. *c. c.* copulatory cushions. *a. m.* arciform or fan-shaped muscular strands, which contract the copulatory region. *i. t. m.* interior transverse muscular strand, ending respectively in the copulatory cushions and in the projecting ventral lobes of the body. Other letters as in the last four figures.

42. The body-wall viewed from the inner side of somites xvii, xviii and xix, showing the genital region of the left side. *pr. m.* prostate muscles connecting this organ with the body-wall. *a. m.* arciform muscles connecting the copulatory cushion with the upper body-wall. *c. c.* copulatory cushion. *sp. m.* muscles connecting the body-wall with the prostate at the junction with the spermduct. *sp. d.* spermduct. *1 and 2 s.* first and second seta. *v. c.* ventral nerve cord. *gl. pr.* glandular prostate. *m. pr.* muscular prostate. *s. m.* smaller muscles, fan-like arranged, confined entirely to the copulatory cushion. *sp. d. p.* spermiducal pore overlaid by muscles. *s.* septa.

43. A somewhat diagonal longitudinal section through the body-wall and copulatory cushion in somite xviii. The section is parallel with the muscular fan of arciform muscles, passing through the copulatory cushion near but not through the body-wall. Illustrating the arrangement of the muscular strands around the prostate in the vicinity of the male pore. The letters indicate the same as in the preceding figure.

44. A longitudinal section through the copulatory cushion and the body-wall, the section being almost vertical. *pr.* prostate, just leaving the arciform muscles, and immediately before bending down towards the prostate pore. *m.* muscles connecting the prostate with the body-wall. *a. m.* the entrance of the arciform muscles into the copulatory cushion.

45. A horizontal section of the body through somite xviii and the copulatory cushions, showing their size and position, etc.

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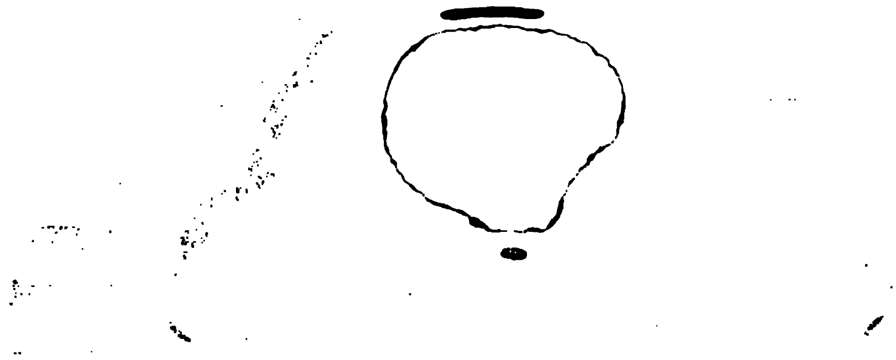

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PLATE XXXVI.

PLATE XXXVI.

PONTODRILUS MICHAELSENI.

46A. Section through the rudimentary gizzard or thickening of the intestinal wall in somite v.

46B. One of the circular muscular strands of the former figure.

46C. Section of the alimentary wall adjoining posteriorly to the rudimentary gizzard in somite vi.

47. A longitudinal section through the intestine showing the glandular-crop in somites xiv, xv, xvi, and the beginning of the sacculated intestine in xvii. *d. v.* dorsal vessel. *d. v. c.* connection between the dorsal vessel and the vascular system of the crop. *gl. cr.* glandular crop. *bl. s.* blood sinus in the outer layer of the glandular layer. *gl. c.* glandular cells constituting the bulk of the crop. *clo.* chloragogen cells. *m. l.* the two muscular layers. *t. i.* the end of the tubular intestine or œsophagus.

48. A section of the former more highly magnified, showing the glandular cells which constitute the crop and the branched lumens which are especially pronounced in the outer part of the layer. *l. m.*, *t. m.* the two muscular layers, which here are not more developed than in any other part of the intestine.

49. Cross-section through the glandular crop in the posterior part of the organ in somite xvi. In this section only few of the glandular cells are found.

50. A section anterior to the former, but in the same somite. Here many more of the glandular cells are seen. In these two sections the chloragogen layer is thick and the cells crowded, similarly the ridges of the epithelial cells are high and separated by deep grooves.

51. A similar cross-section through the crop in somite xv. Both the chloragogen cells and the epithelial cells are lower.

52. Another cross-section showing the entrance of a blood vessel from the dorsal vessel into the vascular system of the glandular crop.

53. A part of the glandular cells of the crop more highly magnified showing the structure of the cells and the branched lumens between them. *gl. c.* glandular cells. *l.* lumen. *bl.* blood sinus. *ep.* inner epithelial cells.

54. An oblique section through the surface of the crop showing the two muscular layers, a blood sinus and a few chloragogic cells cut through. The glandular cells immediately below are not delineated.

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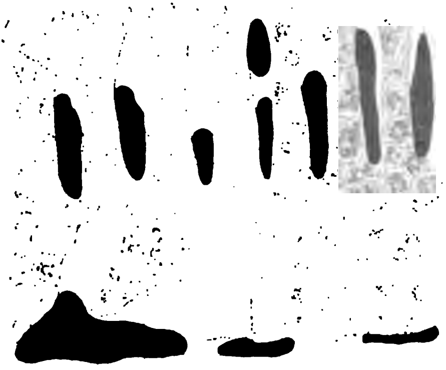

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PLATE XXXVII.

PLATE XXXVII.

PONTODRILUS MICHAELSENI.

55. A spermatheca with its diverticulum seen from interior of the body, when the body-wall is spread out. *spth. p.* spermathecal pore. *d.* diverticulum. *spz.* inner sac-like enlargement where the spermatozoa are massed.

56. A cross-section of the body-wall through the spermatheca near its pore. *v. l.* thin vascular layer or peritoneum. *l. m.* longitudinal muscles. *t. m.* transverse muscles. *hy.* hypodermis. *spz.* spermatozoa. *int. n.* interstitial nuclei. *en.* epithelial nuclei and cells. *c. m.* circular muscles of the spermatheca. *div.* diverticulum.

57. A cross-section of the diverticulum of the spermatheca. *in.* inner nuclei of the epithelium. *ints. n.* interstitial nuclei. *c. m.* circular muscles. *bl.* vascular layer. *gl. c.* exterior glandular layer consisting of a double or triple row of cells.

58. A longitudinal section of the body-wall, somites vii, viii and ix made through the spermathecal pore. *spth. p.* spermathecal pore. *spth.* the lower, enlarged part of the spermatheca, which forms a strongly muscular papilla. *dv.* the junction with the diverticulum. *set.* seta. *l. m.* longitudinal muscles. *t. m.* transverse muscles. *a. s.* anterior septum of somite viii. *p. s.* posterior septum of somite viii.

59. One of the testes.

60. A longitudinal section of one of the testes.

61. An ovary.

62. Longitudinal section of an ovary.

63. Longitudinal section of the oviducal funnel. *s.* septum.

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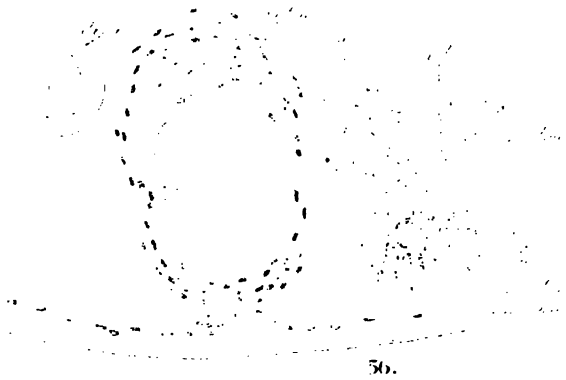

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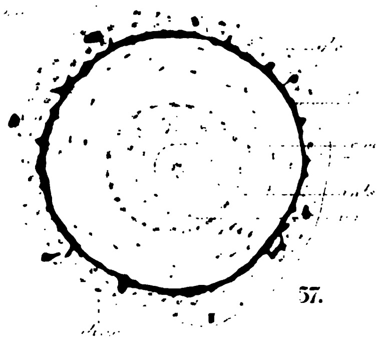

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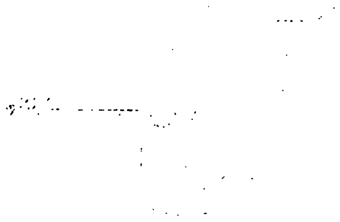

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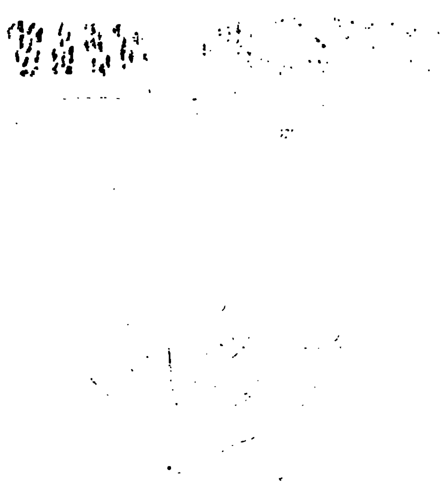

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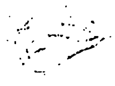

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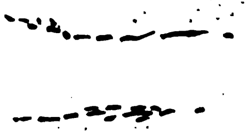

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PLATE XXXVIII.

PLATE XXXVIII.

PONTODRILUS MICHAELSENI.

64. Section through the body in somite xi, showing the sperm-sacs and their relative position. *s.* anterior septum. *d. v.* dorsal vessel. *h.* hearts. *œ.* œsophagus. *v. v.* the branched ventral vessel. *sp. s.* the racemose sperm-sacs situated much ventrally of the intestine. *n. c.* ventral nerve cord. *l. m.* and *t. m.* longitudinal and transverse muscles of the body.

65. A cross-section of the same region more magnified. *s.* x/xi. septum between x/xi. *s.* xi/xii. septum between xi/xii. *sp. s.* one of the sperm-sacs. *spz.* spermatozoa. *m. c.* mother cells. *c. r.* ciliated rosette. *m. m.* muscles connecting the septum below the sperm-sac with the œsophagus.

66. A more longitudinal section of the ciliated rosette, showing the muscles and the blood vessels in the thick funnel.

67. Another section through the ciliated rosette, showing the thick layer of blood vessels below the ciliated epithelium.

68. A cross-section through the glandular part of the prostate, near the entrance of the spermduct. *ep.* epithelial cells with round nuclei. *c. m.* circular muscles. *c.* glandular cells. *m.* muscles connecting with the body-wall. *sp. d.* spermduct.

69. Cross-section through the muscular part of the prostate.

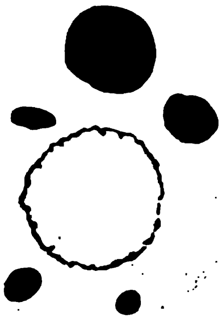
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PLATE XXXVIII.

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65. A cross-section of the same region more magnified. *s.* x/xi. septum between x/xi. *s.* xi/xii. septum between xi/xii. *sp. s.* one of the sperm-sacs. *spz.* spermatozoa. *m. c.* mother cells. *c. r.* ciliated rosette. *m. m.* muscles connecting the septum below the sperm-sac with the œsophagus.

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67. Another section through the ciliated rosette, showing the thick layer of blood vessels below the ciliated epithelium.

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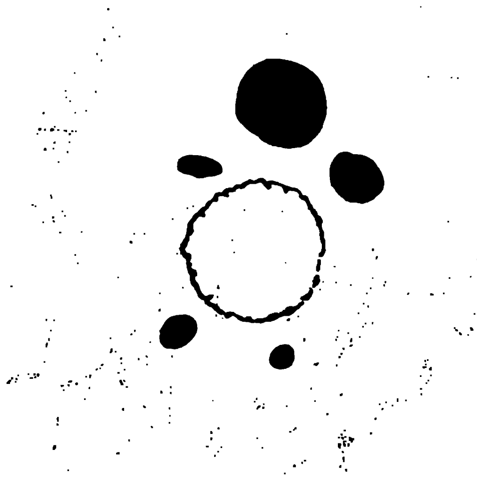

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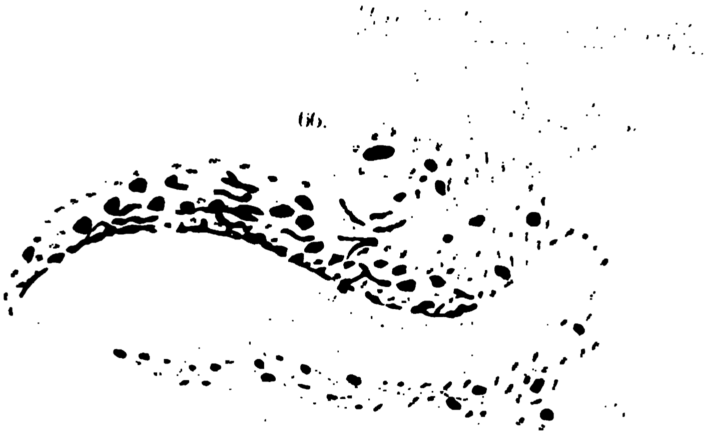

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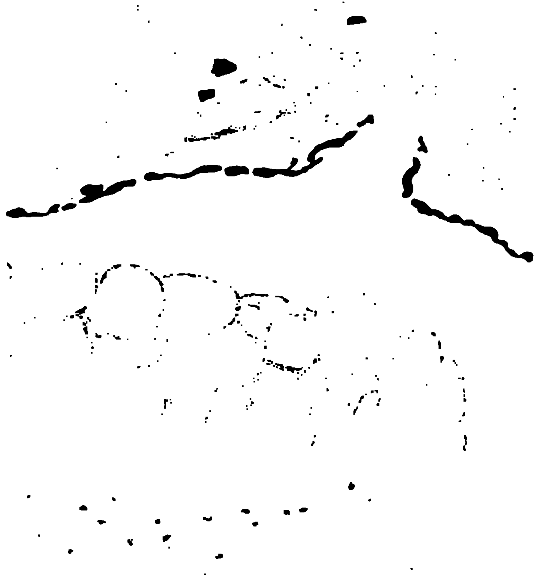

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PLATE XXXIX.

PLATE XXXIX.

PONTODRILUS MICHAELSENI.

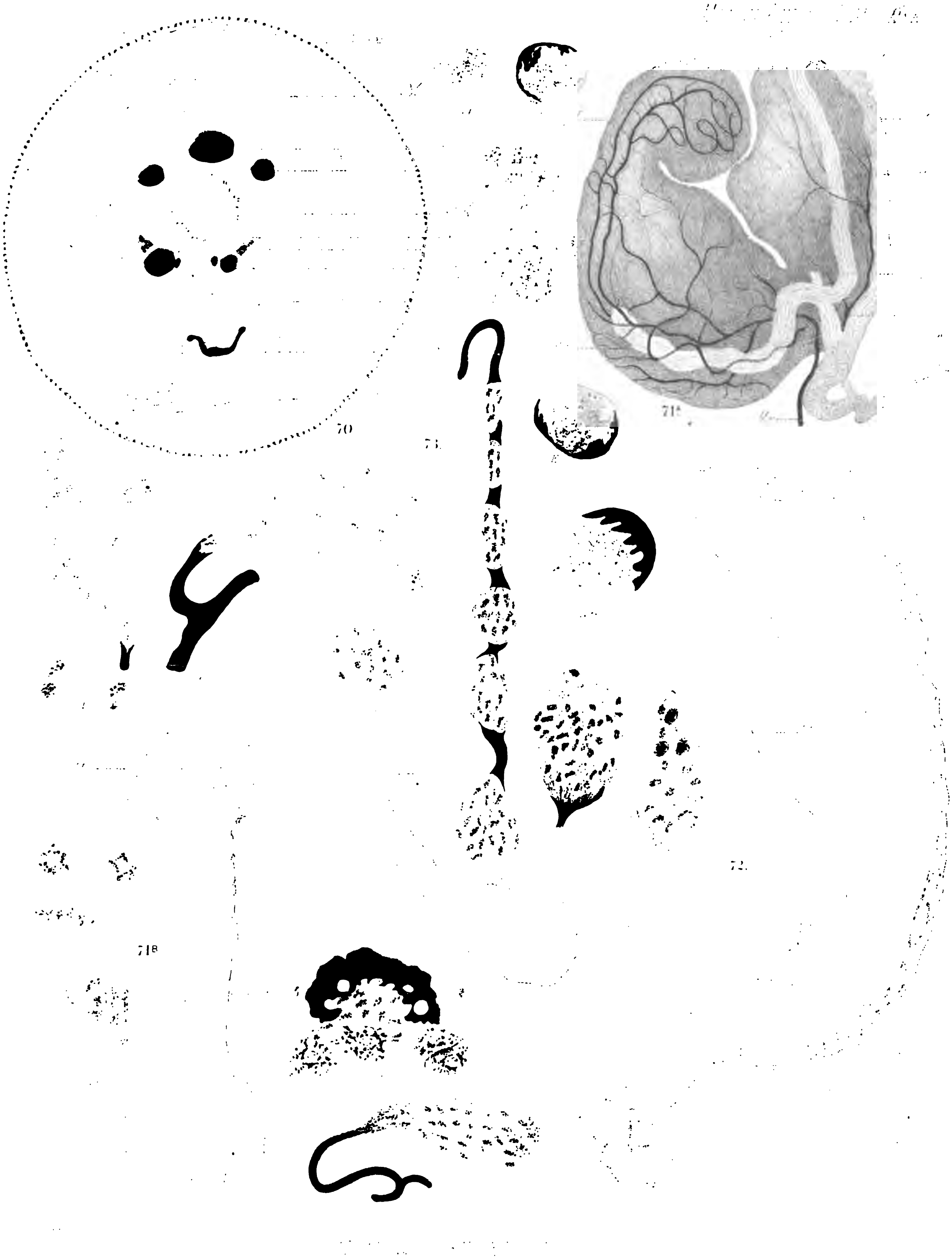
70. Cross-section of the body in somite xi, showing the relative thickness of the septa and body-wall, the septa being very much cupped, showing the œsophagus, etc., of the somite ix, as well as the septum and ciliated rosettes of x. *v. v. x.* the ventral vessel in x where it connects with the hearts. *v. v. ix.* the two forms of the ventral vessel. *gl.* septal gland surrounding the connecting vessels in somite ix. There are five pair of these glands, one each in v, vi, vii, viii, ix.

71A. One of the nephridia isolated. *p. l.* posterior lobe of the peritoneal sac of the nephridium. *a. l.* anterior lobe of the same. *w.* windings of the canals where the two folds meet. *p. f.* and *a. f.* posterior and anterior folds of the canal. *n. p.* nephropore. *n. st.* nephrostome. *spr.* spur with four canals. *br.* bridge. *bl. v.* blood vessels on the nephridium.

71B. Nephrostome isolated. *m.* marginal cells. *w. d.* wide duct. *nec.* neck in which the narrow duct is seen to be branched.

72. An enlarged and somewhat diagrammatic drawing of the course of the ducts, etc., of the nephridium. The letters indicate the same as in the preceding figure. The canals have been represented as further apart than they are in reality, otherwise their course could not have been clearly delineated. When the nephridium is viewed from above mounted in glycerine, the outlines of the canals are only dimly discernible, being greatly obscured by peritoneal cells and blood vessels, neither of which have been delineated. The shape of the neck varies to some extent, in some specimens being much wider than in others.

73. Various forms and sizes of blood-glands from the supra pharyngeal and septal salivary glands. Drawn from parafine sections, hardened in Formaline, and stained: *a.* orange G. alcohol, Ehrlich's hæmatoxylon amm. *b.* rose aniline in hydrochloric alcohol, Bismark brown, and Ehrlich's hæmatoxylon. The latter combination gives by far the finest results, clearly differentiating the blood from the gland-secretion, this being very imperfectly done by the orange G.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71A
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PLATE XL

PLATE XL.

PONTODRILUS MICHAELSENI.

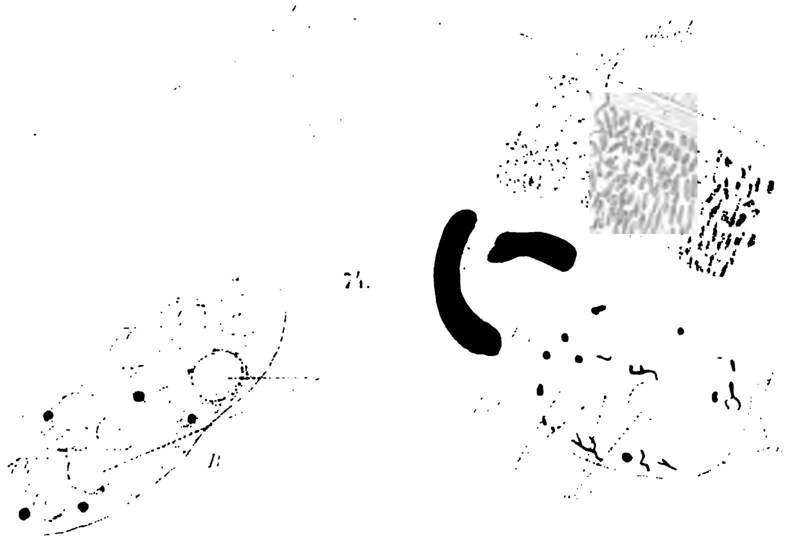
74. Cross-section through the body-wall and through the nephropore and wide duct. The latter is seen to enter the glandular neck of the nephridium (*nec*), its inner duct having been cut twice, these cross-sections being always of unequal width. The section *a* passes through the distal windings of the ducts, the letters in the duct indicating that they belong to the same duct. *c. c.* ciliated canal, always wider than the other. The canal *c.* is a branch or forking of one of the other ducts. At *d.* about an inch of the drawing is left out in order to economize room.

75. Longitudinal section of the nephridium near the windings showing the forkings of one of the canals. *c. c.* is the ciliated larger canal. *b.* is the body of the nephridium, in which are seen the branched canals and lacunes, as well as the branching blood vessels which are held back.

76. Part of the neck in cross-section, a larger magnification of a section similar to *a* 74, showing the branching of the narrow duct *n. d.* The wide duct *w. d. t.* is cut twice; the part marked *w. d.* is the part of the wide duct as it leaves the neck for the exterior pore of the body-wall.

ECLIPIDRILUS FRIGIDUS.

77. A diagrammatic view of the anterior somites of the body, composed from several longitudinal sections. Only part of the vascular system is shown, and none of the nephridia, the principal object being to show the arrangement of the reproductive organs and the shape of the alimentary canal. Sperm-sacs not shown. *br.* brain. *bd.* body-wall. *phx.* pharynx. *c. v.* connecting vessels. *d. v.* dorsal vessel. *v. v.* ventral vessel. *cl.* clitellum. *v. c.* ventral nerve cord. *t.* first and second pair of testes. *spth.* spermatheca. *ov.* ovary. *ovd.* oviduct. *c. r.* inner and outer ciliated rosette. *cl.* clitellar layer of glands. *sps.* spermatozoa. *t.* testes. *chlo.* chloragogen cells. ♂ male pore. *p.* penis. *atr. & pr.* prostate and atrium. *pr. m.* muscular layer of prostate. *pr. g.* glandular part of prostate. *atr.* atrium. *str.* storage chamber for protozoa. *spd.* spermduct. *int.* intestine. *br.* bridge.



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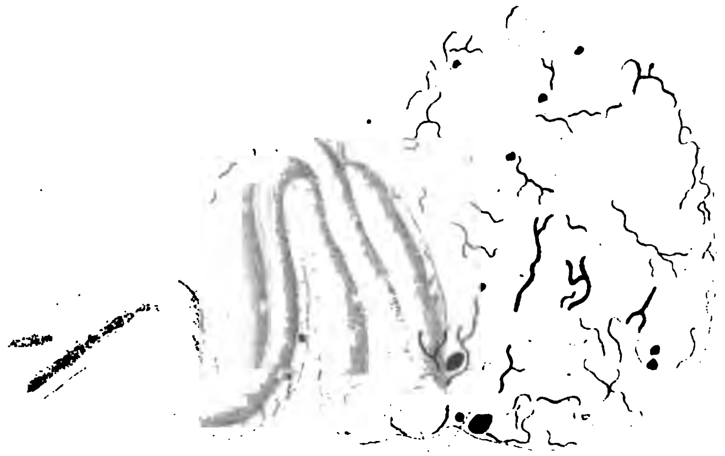

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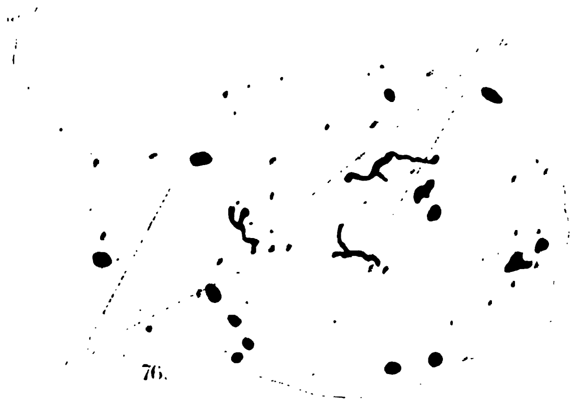

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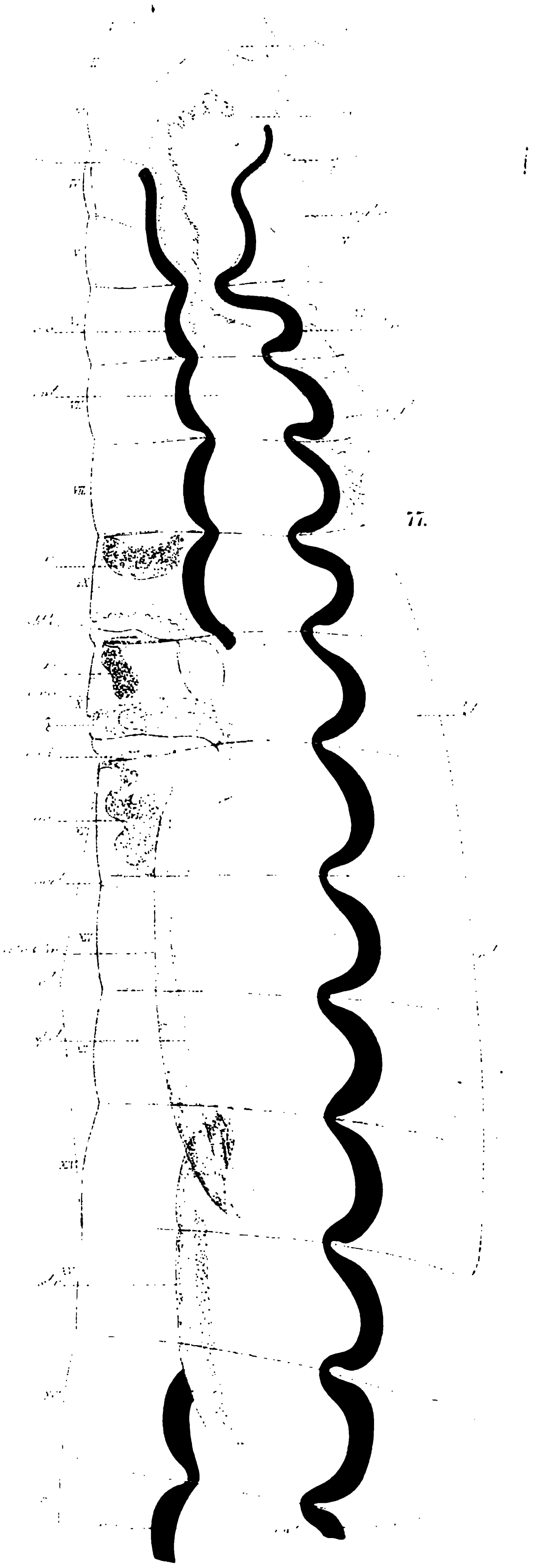

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PLATE XLI.

PLATE XLI.

ECLIPIDRILUS FRIGIDUS.

78. A diagrammatic figure of the region of the reproductive organs, including somites ix to xvii, showing the arrangements of the reproductive organs. The body-wall is represented as being cut open dorsally and spread out. *br.* the bridge or narrow part of the prostate connecting the wide and lower part with the storage chamber of the spermatozoa. *str.* storage chamber of spermatozoa. The prostate and ciliated rosettes are somewhat stretched, as otherwise they could not be seen both at the same time.

79. Part of the clitellum in transverse section, showing the clitellar glands, the longitudinal and transverse muscular layers.

80A. One of the blood glands or herzkörper.

80B. A single gland cell of the former.

81. A transverse section of the dorsal vessel, showing the blood gland occupying the ventral part of the vessel.

82A. Cross-section of the lower part of the spermatheca, at the spermathecal pore. *bd.* body-wall. *ep.* inner lining epithelium. *m.* muscular transverse layer. *ex.* exterior layer. *l. m.* longitudinal muscular layer of the body-wall. *t. m.* transverse muscular layer of the body-wall.

82B. Cross-section of the distal end of the spermatheca.

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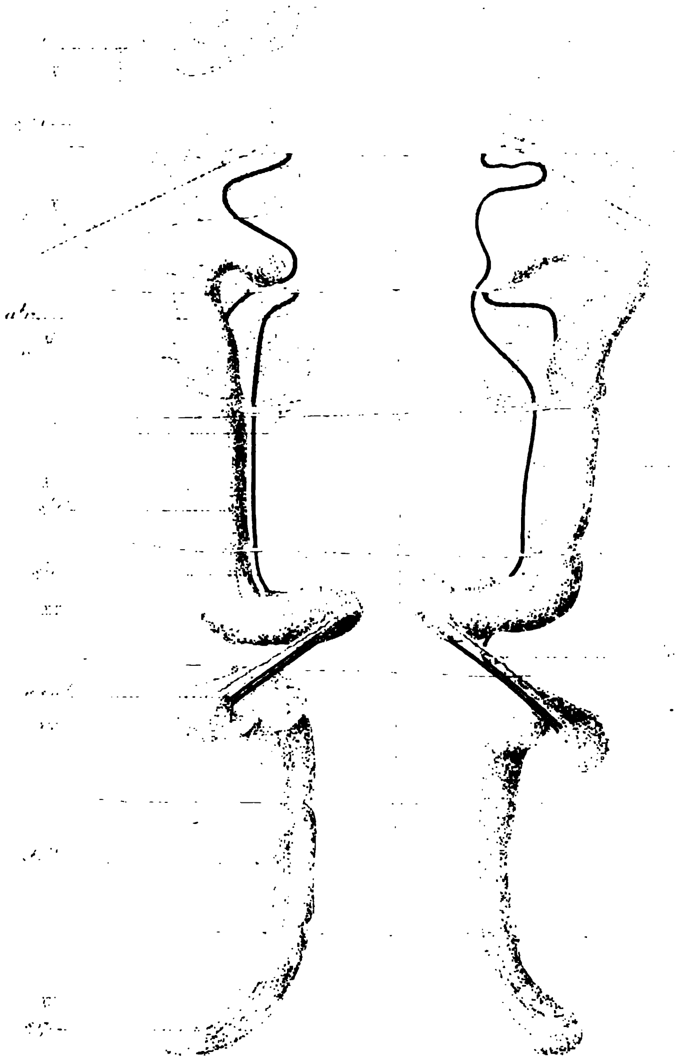

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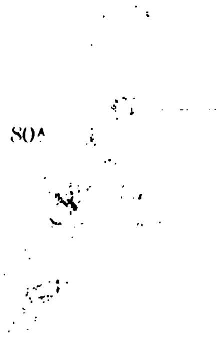

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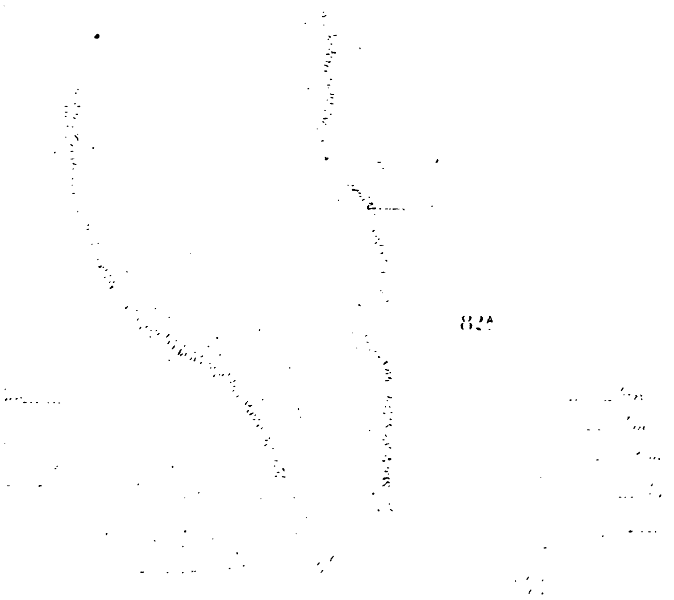

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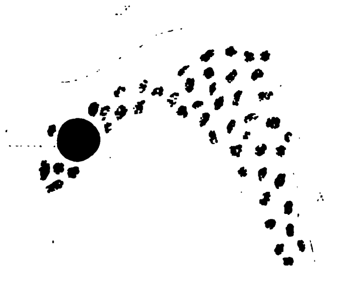

82B

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PLATE XLII.

PLATE XLII.

ECLIPIDRILUS FRIGIDUS.

83–91. Represent somewhat diagrammatic views of transverse section of the body, respectively through somites iii, iv, ix, x, x, xi, xi, xiv and xv. Of somites x and xi sections from the anterior and posterior parts are shown. The following letters are common and indicate the same in each one of the figures: *v. v.* ventral vessel. *d. v.* dorsal vessel. *int.* intestine. *l. m.* longitudinal muscular layer. *t. m.* transverse muscular layer. *v. c.* ventral nerve cord. *m.* muscles and connective tissue uniting the intestine and body-wall. *sp. s.* sperm-sacs. *c. v.* connecting vessels, cut in various places. *phx.* pharynx, shown to be developed only on the upper side of the alimentary canal.

84. The intestine is here seen only to be connected with two superior muscular fascicles with the body-wall. The connecting vessels between the ventral and dorsal vessels are covered with glandular cells, the contents of which stains deeply with hæmatoxylon, and are of a different nature from the chloragogic cells.

85. Section through the first clitellar somite ix. *cl.* clitellar layer. *spth.* spermatheca. *spz.* spermatoza.

86. Section through somite x. In this specimen both the spermatheca project into somite x. The blood vessels which are seen in the sperm-sacs and surrounding the spermatheca are the anterior part of the anterior pair of lateral vessels, which project no further than here.

87. Section through the posterior part of x cutting through the atrium and penis. The ciliated rosettes were not seen in this section, only some parts of the spermduct. The blood vessels seen surrounding the penis and atrium are the anterior parts of the posterior pair of lateral longitudinal vessels.

88. Section through somite xi, close behind the anterior septum, showing the middle part of the outer ciliated rosette cut through. The other rosettes having been torn were not seen on the section. The spermducts are seen as a small circle, one on either side of the prostate.

89. Section through the posterior part of somite xi. The outer spermducts are seen as situated further down, approaching each other, the approach being yet closer in the next section.

90. Section through somite xiv. The prostate being bent zigzag is seen as cut in three different places. At *a* the part anterior to the very narrow part or bridge is seen cut. At *b* this very narrow part and at *c* the posterior part or storage chamber where the spermducts are seen entering the chamber.

91. Section through somite xv. The storage chamber is cut close through its anterior end and is seen surrounded by a thick layer of prostate glands.

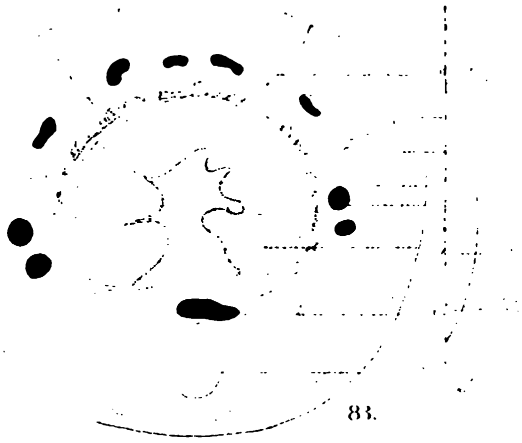
92. Cross-section of the atrium below its junction with the prostate. *gl.* small prostate glands penetrating the outer muscular layer. *m. s.* muscular layer. *tube* tube winding in the inner layer of fibrous tissue. *n.* nuclei of lining layer, boundaries of the cells not distinct probably on account of maceration. A few nuclei only are seen in the fibrous mass, which is much thicker in the center surrounding the tube.

93. Cross-section of the prostate proper in somite xii. *gl. s.* small surface glands penetrating between the longitudinal muscular layer. *m. s.* longitudinal muscular layer composed of fascicles or plates of strands. *t. m.* transverse muscular layer. *gl. c.* thick glandular layer of one row of cells. *l. ep.* lining ep. of cells. *spz.* spermatozoa.

94. Cross-section of the narrow part or bridge of the prostate. The layers are the same as in the preceding figure, but of different relative thicknesses. Letters as in preceding. *sp.* sperm ducts. *out. m.* outer layer of muscles, running in different directions.

95. Cross-section of the storage chamber in somite xv, posterior to the entrance of the spermducts, but very close to it. *sp. d.* spermducts. *gl. s. l.* large surface or prostate glands. *gl. s. s.* small surface or prostate glands. *m. s.* longitudinal layer of muscles. *t. m.* transverse muscles. *ep.* lining epithelium with large nuclei.

96. A somewhat oblique section of the posterior part of the bridge, near its junction with the storage chamber, but anterior to the entrance of the spermducts, showing the relative size of the layers and the increased epithelium in the anterior part. *br.* posterior part of bridge, near its widening. *ep.* lining epithelium. *pr. gl.* prostate glands. *l. m.*, *t. m.* longitudinal and transverse muscular layers, both cut obliquely. Both the transverse muscles and the epithelium are thickened towards one end.



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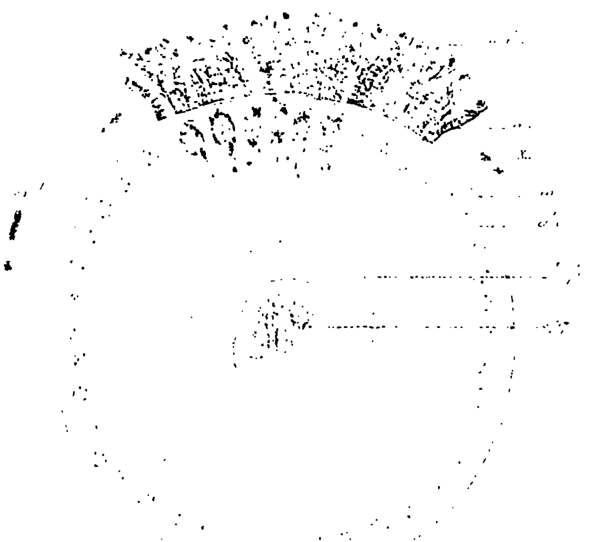

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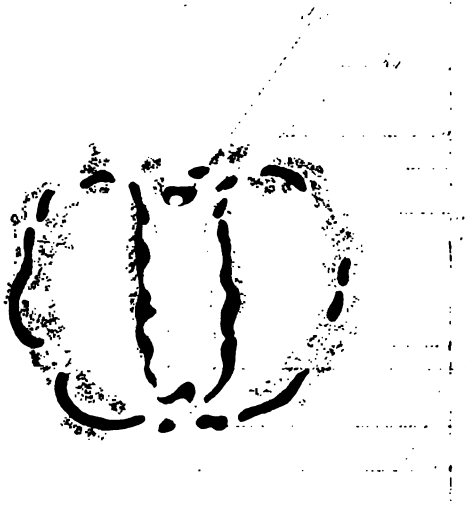

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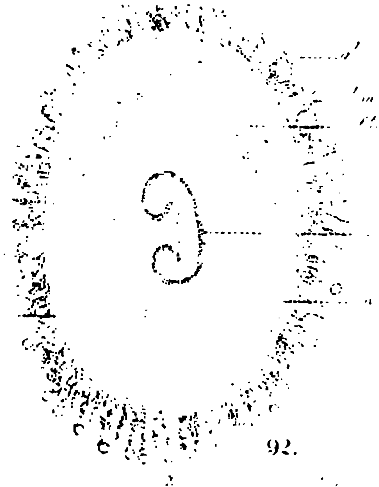

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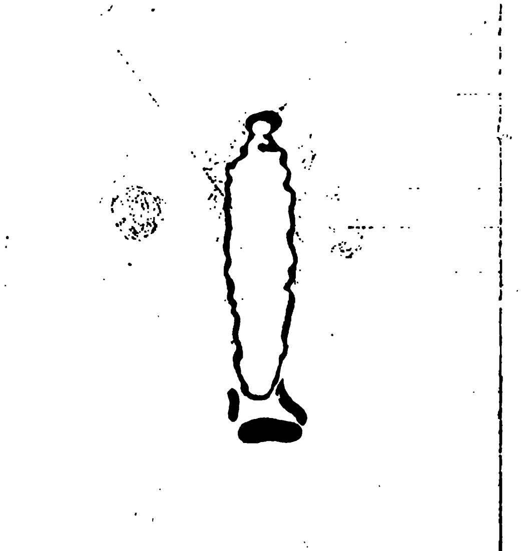

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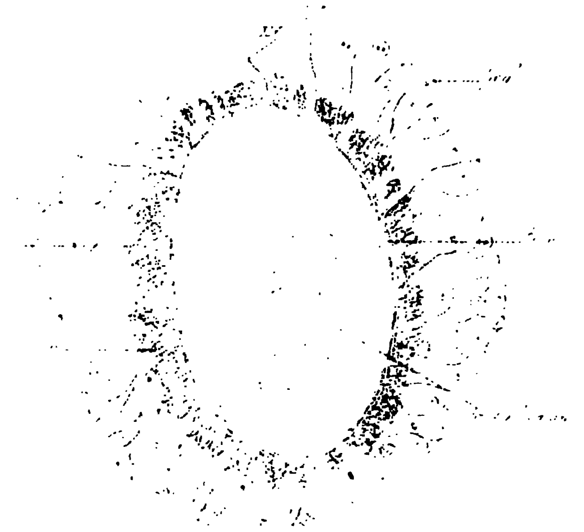

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PLATE XLII.

ECLIPIDRILUS FRIGIDUS.

83-91. Represent somewhat diagrammatic views of transverse section of the body, respectively through somites iii, iv, ix, x, x, xi, xi, xiv and xv. Of somites x and xi sections from the anterior and posterior parts are shown. The following letters are common and indicate the same in each one of the figures: *v. v.* ventral vessel. *d. v.* dorsal vessel. *int.* intestine. *l. m.* longitudinal muscular layer. *t. m.* transverse muscular layer. *v. c.* ventral nerve cord. *m.* muscles and connective tissue uniting the intestine and body-wall. *sp. s.* sperm-sacs. *c. v.* connecting vessels, cut in various places. *phx.* pharynx, shown to be developed only on the upper side of the alimentary canal.

84. The intestine is here seen only to be connected with two superior muscular fascicles with the body-wall. The connecting vessels between the ventral and dorsal vessels are covered with glandular cells, the contents of which stains deeply with hæmatoxylon, and are of a different nature from the chloragogic cells.

85. Section through the first clitellar somite ix. *cl.* clitellar layer. *spth.* spermatheca. *spz.* spermatoza.

86. Section through somite x. In this specimen both the spermatheca project into somite x. The blood vessels which are seen in the sperm-sacs and surrounding the spermatheca are the anterior part of the anterior pair of lateral vessels, which project no further than here.

87. Section through the posterior part of x cutting through the atrium and penis. The ciliated rosettes were not seen in this section, only some parts of the spermduct. The blood vessels seen surrounding the penis and atrium are the anterior parts of the posterior pair of lateral longitudinal vessels.

88. Section through somite xi, close behind the anterior septum, showing the middle part of the outer ciliated rosette cut through. The other rosettes having been torn were not seen on the section. The spermducts are seen as a small circle, one on either side of the prostate.

89. Section through the posterior part of somite xi. The outer spermducts are seen as situated further down, approaching each other, the approach being yet closer in the next section.

90. Section through somite xiv. The prostate being bent zigzag is seen as cut in three different places. At *a* the part anterior to the very narrow part or bridge is seen cut. At *b* this very narrow part and at *c* the posterior part or storage chamber where the spermducts are seen entering the chamber.

91. Section through somite xv. The storage chamber is cut close through its anterior end and is seen surrounded by a thick layer of prostate glands.

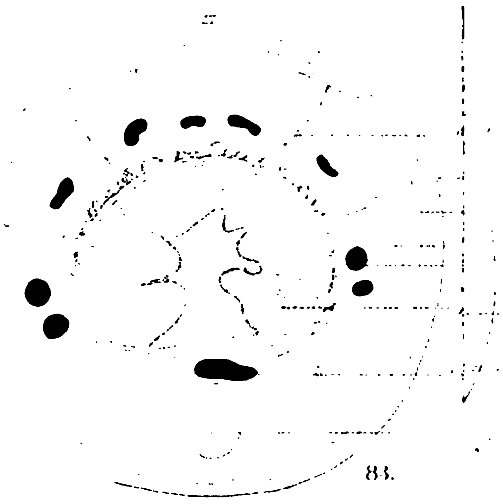
92. Cross-section of the atrium below its junction with the prostate. *gl.* small prostate glands penetrating the outer muscular layer. *m. s.* muscular layer. *tube* tube winding in the inner layer of fibrous tissue. *n.* nuclei of lining layer, boundaries of the cells not distinct probably on account of maceration. A few nuclei only are seen in the fibrous mass, which is much thicker in the center surrounding the tube.

93. Cross-section of the prostate proper in somite xii. *gl. s.* small surface glands penetrating between the longitudinal muscular layer. *m. s.* longitudinal muscular layer composed of fascicles or plates of strands. *t. m.* transverse muscular layer. *gl. c.* thick glandular layer of one row of cells. *l. ep.* lining ep. of cells. *spz.* spermatozoa.

94. Cross-section of the narrow part or bridge of the prostate. The layers are the same as in the preceding figure, but of different relative thicknesses. Letters as in preceding. *sp.* sperm ducts. *out. m.* outer layer of muscles, running in different directions.

95. Cross-section of the storage chamber in somite xv, posterior to the entrance of the spermducts, but very close to it. *sp. d.* spermducts. *gl. s. l.* large surface or prostate glands. *gl. s. s.* small surface or prostate glands. *m. s.* longitudinal layer of muscles. *t. m.* transverse muscles. *ep.* lining epithelium with large nuclei.

96. A somewhat oblique section of the posterior part of the bridge, near its junction with the storage chamber, but anterior to the entrance of the spermducts, showing the relative size of the layers and the increased epithelium in the anterior part. *br.* posterior part of bridge, near its widening. *ep.* lining epithelium. *pr. gl.* prostate glands. *l. m.*, *t. m.* longitudinal and transverse muscular layers, both cut obliquely. Both the transverse muscles and the epithelium are thickened towards one end.



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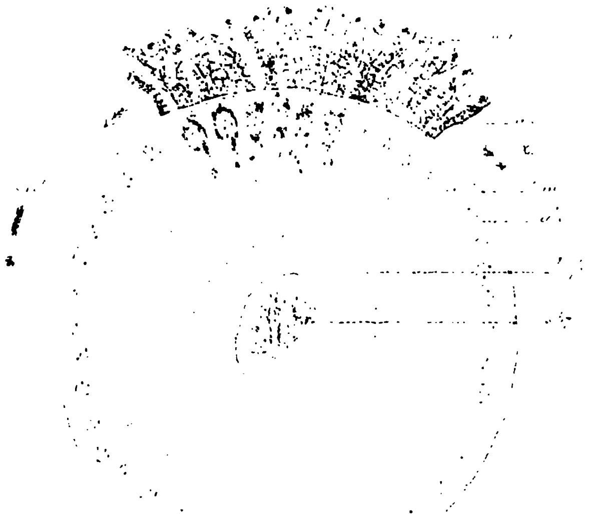

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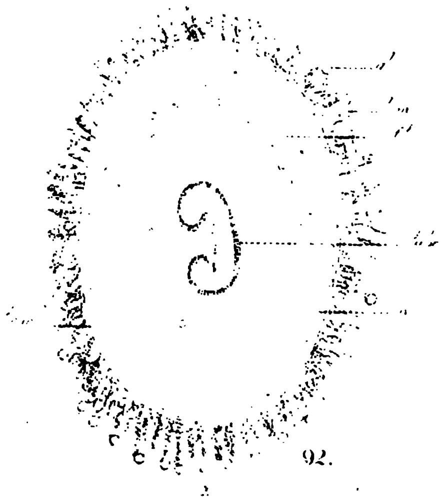

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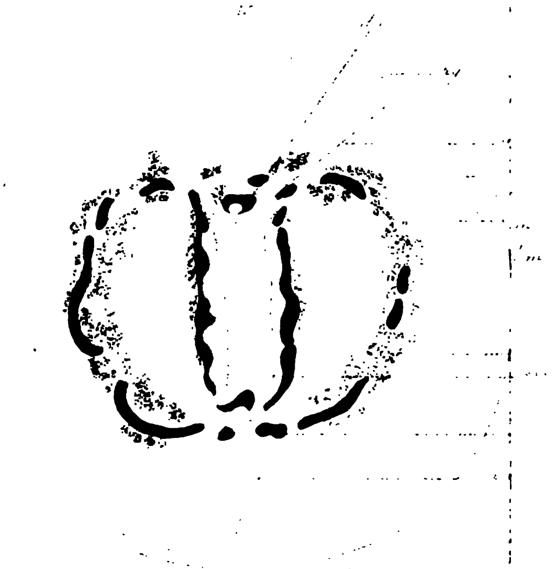

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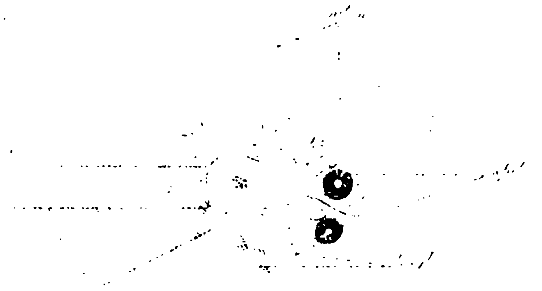

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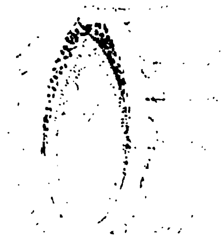

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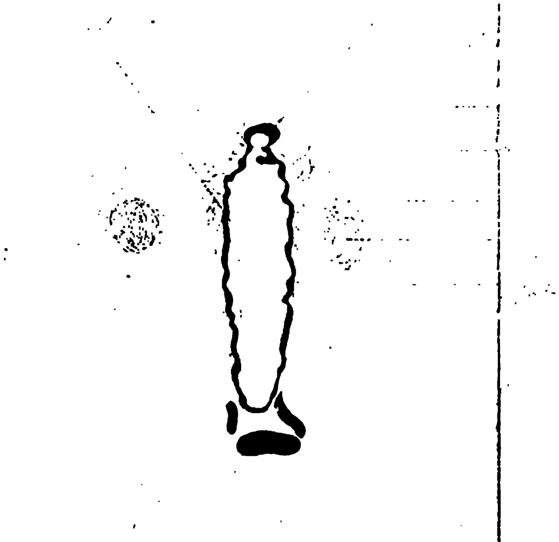

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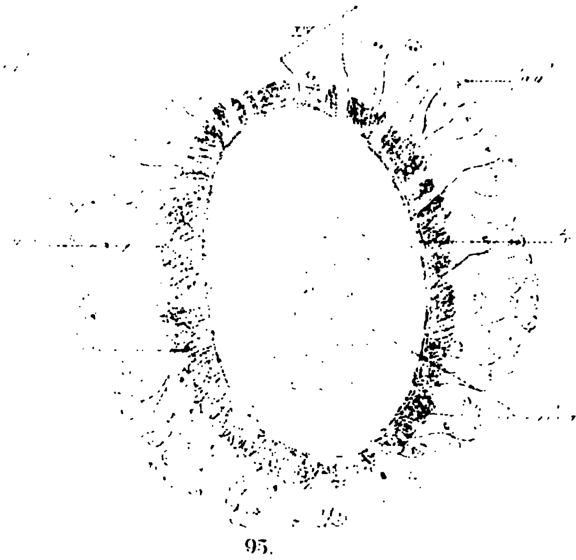

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PLATE XLIII.

PLATE XLIII.

ECLIPIDRILUS FRIGIDUS.

97A. Cross-section of the neck of a nephridium.

97B. Section of the long duct.

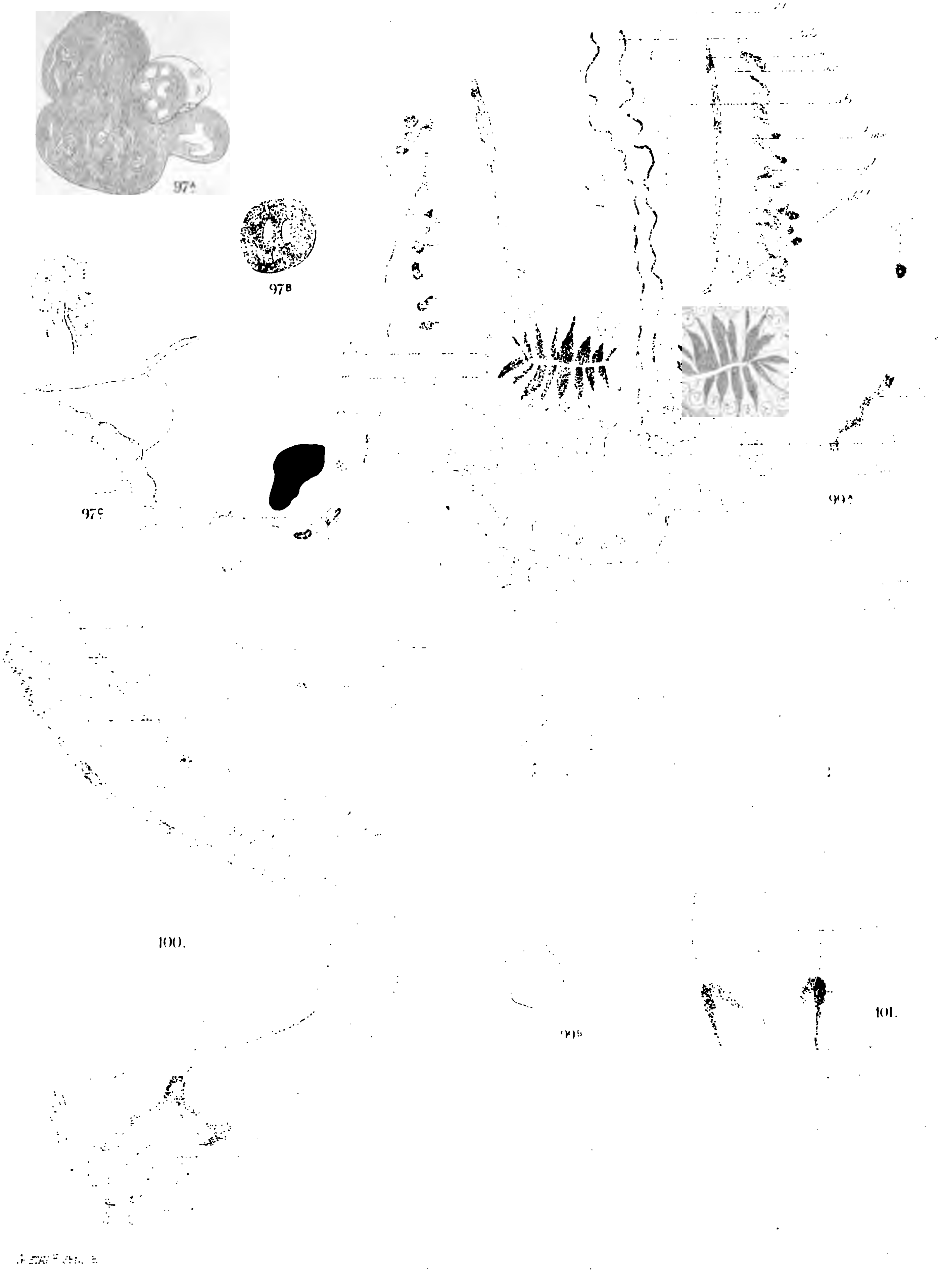
97C. Nephrostome and part of duct.

99A. Section of the lower part of the male organ, slightly oblique to the longitudinal axis of the penis, but parallel to the atrium. *atr.* atrium. *f. t.* fibrous tissue. *in.* inner lining of the atrium with long oval nuclei. *l. ms.* longitudinal muscular layer of atrium. *t. ms.* transverse muscular layer. *gl.* small glands scattered over the surface of atrium and prostate. *spd.* spermduct. *sep.* part of the septum between x/xi. *sphxt.* circular muscles or sphinxter. *gl. c.* large glandular cells composing the collar. *m. p.* muscular plates, to which the longitudinal muscles of the atrium are joined. *tube.* penis tube. *ps.* penis sheath. *pre.* preputium. *bd.* body-wall.

99B. Section of inner penis tube of the former figure.

100. The lower end of the male organ, atrium and prostate in somite x, xi, somewhat diagrammatically figured, in order to show the different layers, penis, etc. *pr.* prostate proper, projecting somewhat into x. *s.* septum. *t. pr.* terminus of prostate. *pr. m.* muscular layer surrounding the prostate. This layer contains numerous glands. *pr. gl.* glandular layer of long flask-like cells. *ep.* inner lining epithelium. *tube* tube running from prostate through penis and atrium—a penis lumen, with thick walls connected with the atrial wall by numerous strands, which on the upper part form a thick layer surrounding the tube, but lower down becomes thin, at least consisting of only few strands. *col.* collar surrounding posterior part of penis. *p.* penis, projective part. *pre.* preputium, eversible. *bd.* body-wall. *f. t.* fibrous tissue.

101. A somewhat larger view of the lower end of the penis. Both this and the former drawing are made from dissections mounted in gum-thus and viewed from above. Letters indicate the same as in fig. 92.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97B
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99A
99B
100.
101.

PLATE XLIV.

PLATE XLIV.

ECLIPIDRILUS FRIGIDUS.

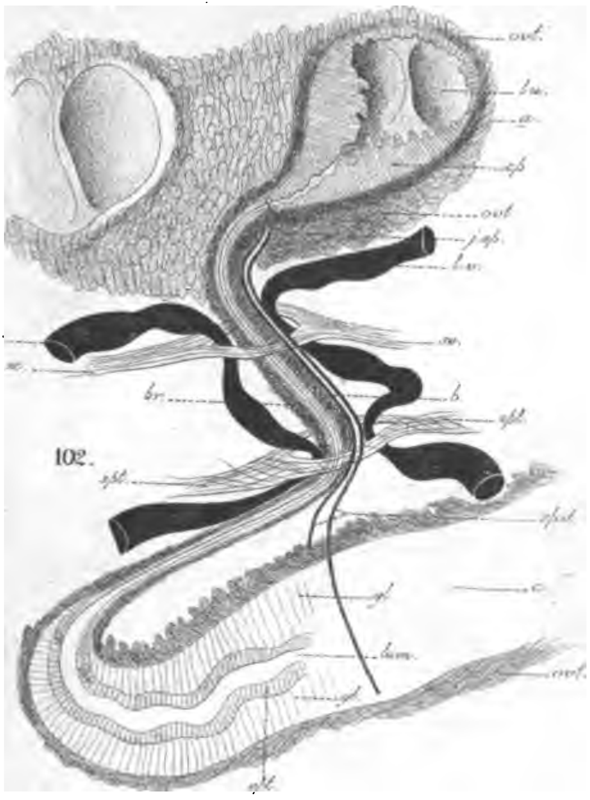
102. The central part of the dissected prostate and male organ, as seen when mounted in gum-thus. This figure represents the narrow part of the prostate or tube, connecting the lower or glandular part with the upper or storage part. The two spermducts are marked much more strongly than they appear and are more spread or separated. The drawing represents views at two different foci. Zeiss C. Eyep. 3, *t*. 165. *a*. the posterior part or storage chamber in which the spermducts open at *j. sp*. The anterior end of this chamber is lined by a very thick epithelium, which however rapidly diminishes in thickness backwards. *b*. the very narrow part connecting the posterior storage chamber with the anterior prostate. *c*. the anterior prostate. *out*. outer layers of the storage chamber and prostate, surface views. *lu*. lumen of storage chamber. *lum*. lumen of prostate. *ep*. very thick epithelium at the anterior end of the storage chamber. *j. sp*. junction of spermducts and storage chamber. *l. v*. lateral longitudinal blood vessels. *se*. septum between xiv/xv. *spt*. septum between xv/xvi. *spd*. spermducts. *br*. narrow part of prostate or bridge. *gl*. glandular layer of prostate. *ept*. lining-epithelium of prostate,

103. The anterior end of the storage chamber, dissected, mounted in gum-thus. The focus is set on the inner concave surface, showing the junction of spermducts and bridge with the storage chamber proper. *sp*. the pores where enter the two spermducts. *outer*. coats of muscles and small prostate glands of the storage chamber. *br*. bridge or narrow part of the prostate.

104. Longitudinal section of the body-wall, showing posterior ciliated rosette, etc., behind the male pore.

105. The inner end of the former more highly magnified. The letters indicate the same as in the last figure. Only some of the larger prostate glands are figured. Zeiss C. Eyep. 3.

106. A part of the former more highly magnified. Zeiss Hom. Im. 1-12, Eyep. 3-155. The letters indicate the same as in fig. 104. This section is more parallel with the longitudinal axis of the organ. The cell walls of the epithelial cells were not distinct, probably on account of maceration.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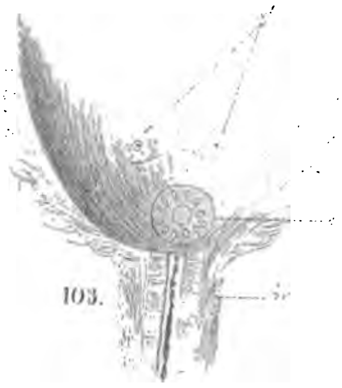
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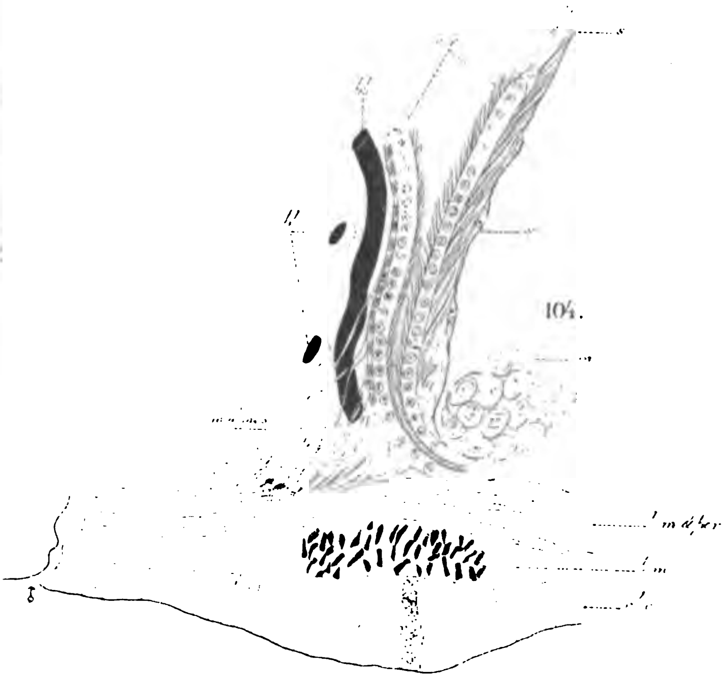
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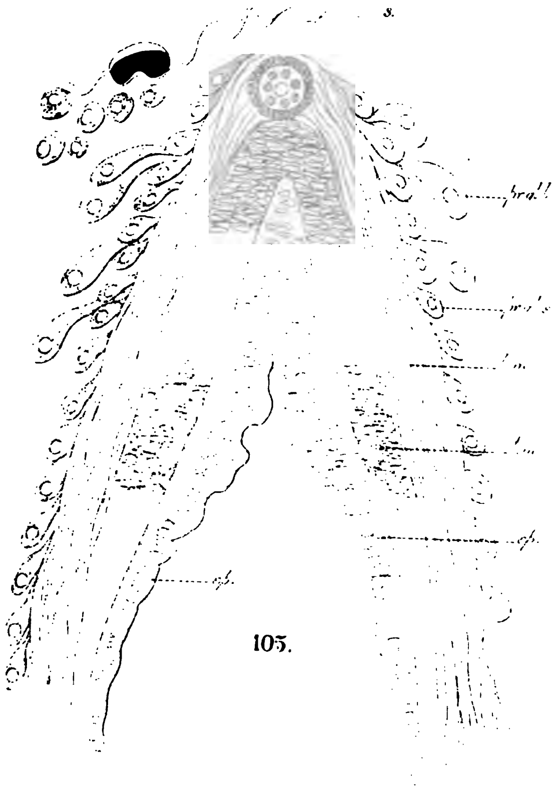
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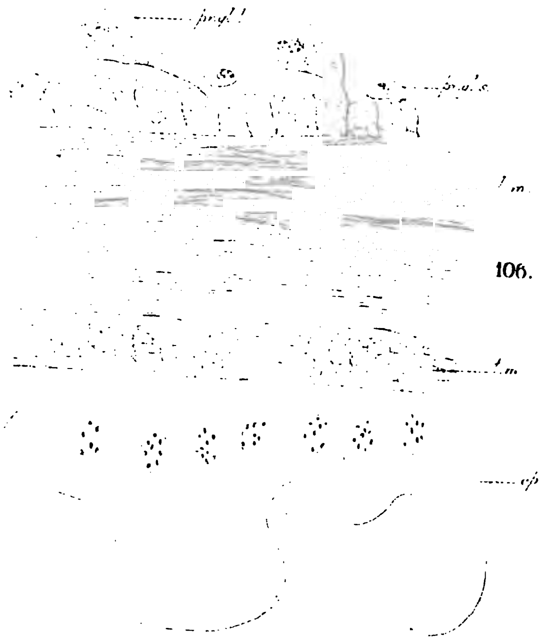
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Gustav Eisen, Del.

Eclipidrilus frigidus Figs. 102 to 106.

PLATE XLV.

PLATE XLV.

ECLIPIDRILUS FRIGIDUS.

107. A transverse section, the storage chamber more highly magnified. Zeiss Hom. Im. 1-12 Eyp. 3. 155. *pr. gl. l.* large prostate glands. *pr. gl. s.* small prostate glands. *l. m.* longitudinal muscles, arranged in strands. *t. m.* transverse muscles. *n.* nuclei of inner lining epithelium.

108A. A dissected ovary.

108B. A ripe ovum.

109A. A dissected oviduct.

109B. Longitudinal section of the body-wall, at the ovipore, showing the latter to be situated in the intersegmental groove.

110 to 124. Various and successive stages of development of spermatozoa.

110. A resting spermatogonium (spermatospore) from the testes.

111. A spermatogonium from the outer edge of the testes ready to fall off into the sperm-sac. The chromosomes of the nucleus have begun to develop into winding rods.

112. Nucleus from a spermatogonium from the sperm-sac.

113. Spermatogemme (spermatosphere or spermpolyblast). The spermatocytes (spermatoblasts) are surrounding and attached to a central, non-nucleated cytophore (or spermblastophore).

114. The same shortly before division of the spermatocytes.

117. A spermatogemme in the next last stage of development. The spermatocytes have through division reached their final number. The cell divisions are indistinct. The nuclei are globular with scattered chromosomes.

118. A further developed or next last stage of the spermatogemme. The nuclei have assumed an ovoid shape, staining very dark with saffranin.

119. A part of a spermatogemme, last stage. The nuclei have again diminished in size and become perfectly round, previous to growing out into spermatozoa.

120. Part of spermatogemme in which the nuclei of 119 have begun to grow out into spermatozoa.

121. A fully developed spermatogemme with grown spermatozoa attached to the cytophore.

122. The same in a state of dissolution, the spermatozoa detaching themselves.

123. Spermatozoa fully developed, the nuclear end being only slightly thicker than the other part of the body.

124–125. Sections of fully developed spermatogemmes, showing spermatozoa in cross-section, they having gradually diminished in diameter since the nuclei were first concentrated (fig. 119), but having proportionately grown in length.

126. Nuclei from 113, 117, 118, show their relative size.

127–129. Yolk sac with yolk cells.

127. The whole sac in section. Zeiss C.

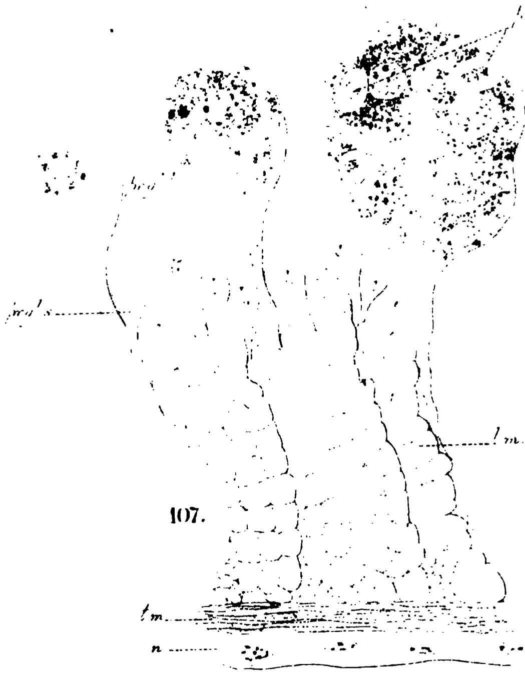
128. Yolk cells without granulation.

129. Further developed yolk cells with granulation.

KERRIA McDONALDI.

130A. Longitudinal section of the alimentary canal of *Kerria McDonaldi* in the somite next posterior to the male aperture, showing unicellular glands alternating with ciliated epithelial cells. *gl.* unicellular glands.

130B. A more highly magnified part of the former, showing one of the unicellular glands, surrounded by common epithelial cells, also rudimentary glands. *r. gl.* rudimentary glands. *gl.* large gland. *p.* its pore. *ep.* epithelial cells. *bl. v.* blood-lacune. *l. m.* longitudinal muscles. *t. m.* transverse muscles.



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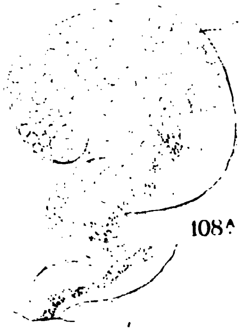

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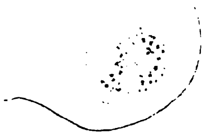

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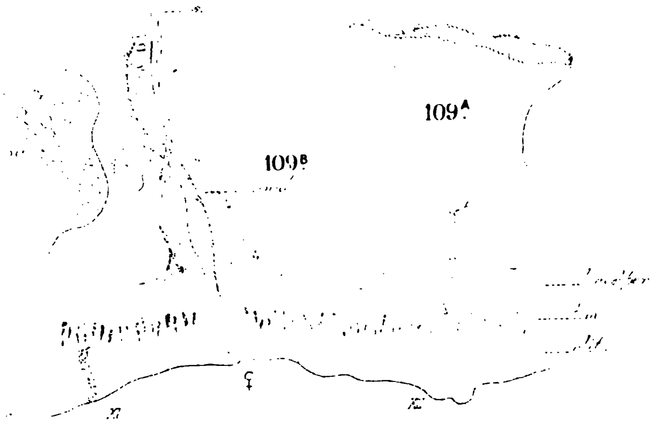

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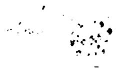

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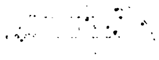

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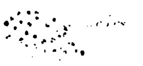

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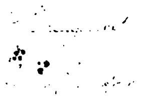

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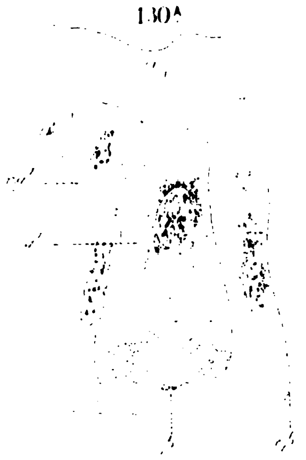

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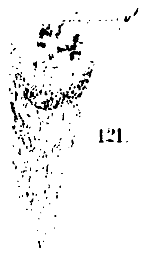

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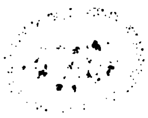

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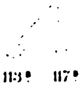

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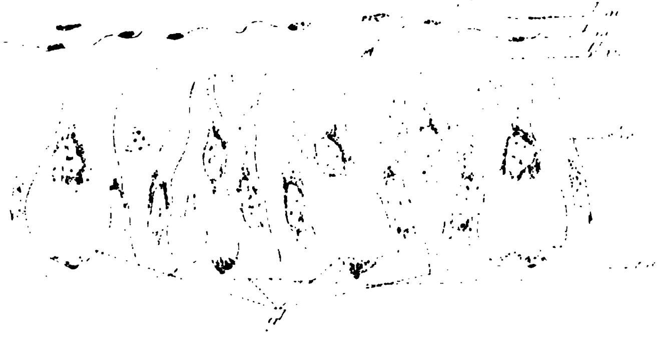

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VOL. II, NO. 5.

PACIFIC COAST OLIGOCHÆTA.

II.

BY GUSTAV EISEN.

SAN FRANCISCO, CAL.,
FEBRUARY, 1896.

PACIFIC COAST OLIGOCHÆTA.

II.

BENHAMIA, ACANTHODRILUS, ALEODRILUS, SPARGANOPHILUS, DELTANIA, PHŒNICODRILUS.

BY GUSTAV EISEN, PH. D.

The following genera and species are treated of in this paper:

Benhamia nana n. sp.
Benhamia mexicana Rosa.
Benhamia Bolavi Michaelsen.
Benhamia palmicola n. subsp.
Benhamia papillata n. sp.
Benhamia rugosa n. sp.
Benhamia octonephra Rosa.
Benhamia Godeffroyi Michaelsen.
Benhamia malayana Horst.
Benhamia floresiana Horst.
Benhamia Annæ Horst.
Acanthodrilus tamajusi n. sp.
Acanthodrilus Vasliti n. sp.
Aleodrilus Keyesi n. sp.
Sparganophilus Benhami n. sp.
Sparganophilus Smithi n. sp.
Sparganophilus sonomæ n. subsp.
Sparganophilus Eiseni Smith.
Sparganophilus guatemalensis n. subsp.
Sparganophilus carneus n. sp.
Sparganophilus tamesis Benham.
Deltania Troyeri var. **crassa** n. var.
Deltania Troyeri var. **lagunæ** n. var.
Phœnicodrilus taste Eisen.
Phœnicodrilus tepicensis n. sp.

BENHAMIA Michaelsen.

The genus Benhamia was for some time considered a typical African genus, and when later on a few extra-African species were found it was supposed that these were recent emigrants, which had become more or less cosmopolitan. Of American species two are known from Mexico and Venezuela, viz.: *B. Bolavi* and *B. mexicana*, and one, *B. octonephra* Rosa, has been described from Paraguay since this paper was presented for publication. This latter species appears very nearly related to *B. rugosa*, described below, but differs through the absence of penial setæ.

The discovery of species of Benhamia at Miraflores, in the Cape Region of Baja California, in a locality to which plants of any kind have rarely if ever been introduced directly from foreign countries, would indicate that this genus has possessed representatives on American soil for ages past, and that we really must consider these American species as truly endemic. A final answer to this question of habitat must be deferred to a future time, when more researches will have been made as regards the distribution of these and other Benhamia species, as it is probable many more will be found on this continent. A difficulty, which besets us from the beginning, is, that so few species have been properly delineated, all descriptions having been made chiefly with a view to distinguish the species from others already known, while with proper delineations of the various organs, we would in all probability be able to make a satisfactory comparison between species new and old. I have received much aid from Dr. W. Michaelsen, of Hamburg, who has described more Benhamia species than any other investigator, and who has written extensively upon this genus. He has kindly placed at my disposal several species of African Benhamia, as well as of *B. Bolavi*, for comparison with forms found by me. This has enabled me to point out several important differences between *B. Bolavi* and *B. palmicola*, which are sufficient to distinguish these as subspecies from each other, as well as from others previously known. At the end of the descriptions of the various new species I append a table of characteristics, etc., between species which may be confounded with our present ones, either on account of similarity of some characters or because of their geographical distribution in the Malay archipelago, or in America.

As we now understand the distribution of this genus, the species are divided as follows: America, 7 species; Malay archipelago, 3 species; Africa, 25 species; West Indies, 2 species.

It may, however, be remarked that *B. rugosa* described below is of uncertain habitat having only been found in a hot-house, to which it had been imported from unknown country.

Considering our various new species of Benhamia this genus may be characterized as below:

Benhamia Michaelsen.

Acanthodrilid oligochæta. Setæ strictly paired, ventral and lateral. Clitellum generally incomplete, but in some species complete in some somites. Two gizzards in succeeding somites. Calciferous glands generally three pairs, but sometimes only two pairs, very distinctly set off from the tubular intestine. Nephridia in respective species either diffuse or micronephridia arranged in three, four or more rows on either side, some species showing several gradations. Spermatheca two pairs, contracted at center with one or more small diverticula, Penial setæ nearly always present. Generally small, tropical worms.

DEFINITIONS OF AMERICAN SPECIES OF BENHAMIA.

Benhamia nana n. sp.

DEFINITION. *Size—Length 20 to 30 mm.; number of somites 110; skin strongly pigmented. First dorsal pore between iii/iv. Prostomium very swollen and overlapping. Clitellum complete in central somites. Penial setæ, the largest with 12 or more bristles. Common setæ, distance between the dorsal couples about equal to that between the ventral couples. Oviducts, two pores, open in front of 1 and 2. Prostate pores not on papillæ. Pharynx situated very far forward. Gizzards in viii and ix. Calciferous diverticula, two pairs in xv and xvi. Sperm-sacs in x and xi. Spermducts thicker at the base in xviii, xvii and xvi. Nephridia in three rows on either side, the posterior with cœlomic mantle. Spermatheca, basal part with one diverticulum, apical part warty and irregular. Typhlosole large, begins in xviii. Color brownish red. Habitat, San Blas, Mexico, at sea level.*

Benhamia mexicana Rosa.

DEFINITION. *Length 30 mm.; number of somites 120. Skin not pigmented. First dorsal pore between iii/iv. Prostomium divides the first somite completely. Clitellum complete in xiii to xxi. Penial setæ not ornamented (?); common setæ, 3 and 4 further apart than 1 and 2. Oviducts, two separate pores in front of 1 and 2, on small papillæ. Gizzards in viii and ix. Calciferous gland 3 pairs in xv, xvi and xvii. Nephridia in 3 rows on either side. Spermatheca with a single short diverticulum. Alcoholic specimen colorless. Habitat, Durango, Mexico, at 2500 meters altitude.*

Benhamia Bolavi Michaelsen.

DEFINITION. *Length 40 to 60 mm.; number of somites 97. First dorsal pore between v/vi. Clitellum incomplete in all somites, xiii to xx. Penial setæ, the largest with five to eight notches, the smaller spoonlike and slightly forked; common setæ couples equidistant. Oviducts open in one single pore on a median papilla in xiv. Gizzard two in vii. Calciferous gland three pairs in xv, xvi and xvii. Sperm-sacs one pair in xi. Nephridia in three rows on either side. Spermatheca, the basal part with a single small diverticulum. Saculated intestine begins in xxi. Color dingy flesh. Habitat, Venezuela (and Hamburg).*

Benhamia palmicola n. subsp.

DEFINITION. *Length 50 to 60 mm.; number of somites 90. Skin not pigmented. First dorsal pore between iv/v. Clitellum incomplete in all somites. Penial setæ, largest with four notches, the smaller one spoonlike and forked; common setæ about equal distance between the dorsal and ventral as between the ventral couples. Oviducts open in one single pore on a median papilla. Gizzards both in viii. Calciferous gland 3 pairs in* *xv, xvi and xvii. Sperm-sacs in xi and xii. Spermducts of even width. Nephidia in 3 distinct rows on either side. Spermatheca basal division globular, equal in size and shape to the apical part, single small diverticulum. A typhlosole. Color reddish flesh. Habitat, Baja California, Cape Region, 1000 feet; Tepic, Mexico, 4000 feet.*

Benhamia papillata n. sp.

DEFINITION. *Size 50 to 70 mm. by 2 mm. Number of somites 125. First dorsal pore v/vi. Prostomium divides somite 1 more than one-half, and is much swollen. Clitellum complete, xiii–xx. No ventral setæ in xviii, but setæ 3 and 4 present. Prostate pores on large papillæ, the four papillæ being close together in the sunk clitellar pit. Oviducal pores on a large median papilla, but the pores are separate and on a line drawn between the setæ. Penial setæ, largest slightly hooked with 8 indistinct notches, smallest with a hair-like sigmoid tip. Spermathecæ, the apical-sac not globular, basal part with a swell diverticulum. Sacculated intestine commences in xix. Typhlosole in xx–xiv. Calciferous diverticula 3 pairs in xvi, xvii, xviii; the anterior one is much smaller. Sperm-sacs in x and xi. Nepridia a consists of three distinct lobes, each one with a cœlomic mantle. Color pale flesh, no pigment. Habitat, Tepic, Mexico, 4000 feet.*

Benhamia octonephra Rosa.

DEFINITION. Compiled after Rosa. *Length 20 to 40 mm.; number of somites 85 to 95. First dorsal pore between v and vi. Clitellum incomplete, in xiii to xx. Penial setæ, the larger with six groups of two blunt tubercles; the smaller seta like a scalpel. Common setæ, couples equidistant. Oviducts open into a single median pore on a slight swelling. Calciferous diverticula three pairs in xv, xvi and xvii. Sperm-sacs in xi and xii. Nephridia micronephric in four rows on either side. Spermatheca, basal part pear-haped with a globular diverticulum. Habitat, Paraguay.*

Benhamia rugosa n. sp.

DEFINITION. *Length 30 mm.; number of somites 118. Skin slightly pigmented and corrugated. Clitellum incomplete, in xiii to xx. Penial setæ, largest with five notches; smaller seta forked with prongs of equal size. Common setæ pointed and ventral. Oviducts open jointly in a median pore. Gizzard in vii and viii. Calciferous diverticula in xv, xvi and xvii. Nephridia micronephric in four rows on either side. Typhlosole present. Spermatheca much flattened. Color reddish flesh. Habitat, California, in hothouse* (*imported*).

Benhamia Godeffroyi Michaelsen.

DEFINITION. *Length 90 mm. by 4 mm.; number of somites 174. Skin pigmented anteriorly. Clitellum incomplete (xiii) xiv to xx. Penial setæ slender with numerous irregular notches; many setæ in each sac. The curved fossa between the prostate pores with the convex side toward the median line. The anterior prostate largest. Calciferous diverticula three pairs. Nephridia plectonephric. Spermatheca without diverticulum, but with warty protuberance. Color, anterior pale reddish, posterior part gray. Habitat, Hayti (?).*

DETAILED DESCRIPTION OF NEW SPECIES.

Benhamia nana n. sp.

Figs. 1–42.

Habitat. San Blas, territory of Tepic, Mexico. I found a small number of specimens, of which only two possessed a perfectly developed clitellum, October, 1894. A real tropical form.

Color. Deep reddish-brown and very opaque.

EXTERIOR CHARACTERS.

Size small, 20 to 30 mm.

Somites 110.

Clitellum comprises somites xiii to xx, being complete in the central somites, but incomplete in xiii, xvii, xviii and xix.

First dorsal pore iii-iv.

Spermathecal pores, one pair vii-viii, and one pair between viii-ix, rather close together in a ventral grove.

Oviducal pores open separately in xiv in front of setæ 1 and 2.

Prostate pores, one pair in xvii, one pair in xix, open with penial setæ.

Penial setæ, two in each pocket, the largest of which is furnished with 12 or more bristles.

Common setæ, distance between the dorsal couples equal to that of the ventral couples.

INTERNAL CHARACTERS.

Buccal cavity with a dorsal pocket.

Suprapharyngeal glands with pharynx opening far forwards.

Gizzards in viii and ix.

Calciferous glands two pairs, one in xiv, one in xv.

Septal glands very minute in ix, x, xi.

Sacculated intestine commences in xiv.

Typhlosole very strongly developed in xviii to xxii.

Sperm-sacs two pairs in x, xi.

Ciliated rosettes in x, xi. The lower part of the spermducts in xvi, xvii, xviii is thickened and twice the diameter of the anterior part.

Prostates are straight and tubular, each one confined to one or two somites.

Spermathecæ in vii–viii, viii–ix. The apical part much smaller than the basal part, the latter with a small diverticulum placed high up near the constriction.

Nephridia arranged in three rows on either side of the median line. Pair *a* open in front of the outer couple of setæ, pair *b* and *c* open laterally and dorsally as regards the setæ. The posterior nephridia furnished with a large cœlomic cellular mantle. The nephridia in each somite of about equal size. The nephridia on each side about equidistant, but the dorsal nephridia *c* are much further apart from the median line than from nephridia *b*.

DETAILED DESCRIPTION.

Body-wall. The prostomium with buccal cavity is strongly eversible, forming a bladder-like apex to the body, as is so frequent in oligochæta. Somite i is very narrow, especially laterally, and may readily, when viewed from the exterior, be taken for part of the prostomium.

The body-wall contains the usual layers of which the muscular fibers show the same bipinnate arrangement as in Lumbricus, etc. This arrangement is less regular and pronounced in the anterior somites, but quite plain in the genital and clitellar ones, especially so on the ventral side, immediately below the nerve-cord.

Sense organs of the epidermis. All the species of Benhamia described here possess a continuous row of sense organs, in the equatorial plane of each somite, between the setæ. Outside of this equatorial circle I have not found them anywhere in the epidermis; there, however, they are very plain and prominent, appearing under low power and in longitudinal sections, as a large pellucid spot in the center of each somite. The organ consists of two distinct kinds of cells, a double line of large lunate cells, surrounding a row of sense cells, several layers thick. These lunate cells are generally three or more thick in the row, evidently modifications of the common goblet cells of the epidermis. They do not stain with the ordinary aniline colors, or only so with difficulty, and generally remain transparent and white. These lunate cells run continuously around the somite, and enclose between them bunches of sense cells, which may now and then be seen to penetrate the cuticle (fig. 20). Somewhat similar sense organs have been known in Lumbricus, etc., for considerable time, but have lately been described more in detail by Richard Hesse and F. E. Langdon. The sense organs of Benhamia differ from those of *Lumbricus agricola* (probably a collective name used for some East American Allolobophora) in two prominent points. Presence of the large lunate cells in Benhamia, which are not seen in Lumbricus. The continuous and broad circle of these organs in Benhamia, while in Lumbricus they appear to be much further apart. Unfortunately my Benhamias were collected at a time when no special preparation for nerve structure was feasible, and this made it impossible to work out the details as minutely as desirable. The work had already been finished when Langdon's beautiful paper reached me. Fig. 20 represents a section of the body-wall in somite iv. Letters *org.* signify the sense organ.

Besides these epidermal sense organs I find in all the Benhamias, observed by me, a large zone in the buccal cavity characterized by almost cubical transparent cells arranged in one single row deep, just as the epithelial cells in the pharynx, but of the same nature as the transparent cells in the sense organs of the epidermis. This zone is nearly always folded against itself like a sac, and is of considerable extent, as long or longer even than the pharynx. In certain places apparently scattered about, but principally near the opening of this sac, I find clusters of sense cells of the same structure as those of the epidermis. They are all narrow, do not reach below in the cœlomic cavity, but end in this direction in line with the pellucid cells and connect at the end with nerve fibres. The free ends penetrate above in what appears as a veritable cuticle, though I can find none above the pellucid cells. In fact the whole structure of these organs is very much the same as the sense organs of the epidermis of the body-wall. In connection with them I may point out the similarity of structure of these organs with those described below in *Acanthodrilus Vasliti*, in the vicinity of the prostates; and with those in the tubercula pubertatis of *Sparganophilus Smithi* and *tepicensis*, in all of which I find the same sense cells.

It remains to add that this pouch-like area of sense cells and glandular cells has previously been observed by both Michaelsen and Horst and designated as a diverticulum of the buccal cavity, but the true nature of the pouch as a sense-area has, I believe, not been previously recognized. *B. Bolavi*, *malayana* and probably most, if not all other, Benhamias possess this organ of the buccal cavity.

Septa. These are generally very thin, only two being thicker than the rest, viz.: xii–xiii and xiii–xiv. These septa do not strictly correspond with the intersegmental grooves, but are affixed much further back in the somites.

Pharyngeal and *septal glands.* The usual supra-pharyngeal glands are present. They are evidently unicellular and arranged ribbon-like as will be directly described below. The septal glands are found in ix, x and xi, are very narrow and only one cell thick in the row as the former. These glandular masses are much thicker in *B. palmicola*, but not any longer.

Intestine. In all the specimens which I could examine I found the pharyngeal parts strongly everted and protruded to such an extent that it formed the lip or front margin of the body, taking the usual place of prostomium proper. I cannot ascribe this entirely to a simple protrusion of the pharynx, but believe that this part is actually situated much more forward than in other species, as I found it to be the case in every specimen observed. The pharynx was found actually on the outside of the body (figs. 15, 16, 17, 18). The real pharynx, of course, is the zone in which open the supra-pharyngeal glands. The wall of this part is in our present species hardly thicker than those of the buccal cavity and the œsophagus, but it contains the usual arrangement of narrow epithelial cells, between which penetrate the fine ducts from the supra-pharyngeal glands. The ends or discharge pockets of these glands are almost globular or rounded flask-like (fig. 18). The supra-pharyngeal glands are arranged as ribbons, running singly along muscular strands. They differ from similar glands in Pontodrilus, Phœnicodrilus, Ocnerodrilus etc., by their arrangement in single rows, and here and there the duct of a single glandular cell may be followed clear to the discharge pocket (fig. 16). These glands appear to consist of a single cell with a long duct, just as the corresponding glands in Euchytræus, described by Hesse. But to draw the conclusion from this fact, that all the pharyngeal and septal glands are unicellular is, I think, premature. In Pontodrilus, at least, there may be seen plainly numerous nuclei on the gland ducts, which, of course, indicates that we here have a fusion of several cells. The pharyngeal glands in that genus do not show this ribbon-like arrangement as in Benhamia. I could, however, see that some of the smaller glands nearest the pharynx consisted of only one cell, but the majority, and all the large glands, consisted of several cells, the respective ducts of which finally united into one. In Benhamia I could see no such union, and the single ducts could be followed with great facility to the outlets. Fig. 17 represents some of these cells with three narrow ducts and secreted matter.

Œsophagus, following pharyngeal division, is very long. The upper part, immediately below the pharyngeal gland, is very thin-walled, consisting of only one strand each of transverse and longitudinal muscles, and lined by a very narrow epithelium (fig. 19). Posteriorly the walls of the œsophagus thicken considerably. The two distinct gizzards are in viii and ix, as usually connected by a very thin wall of the same general nature as œsophagus (fig. 7). The muscles of the gizzards are columnar but not bipinnately arranged, the ribbons running parallel with the short diameter of the body (figs. 7 and 21).

The tubular intestine extends through somites x to xiv, being of irregular outline. Sacculated intestine commences in xv, and is furnished with a typhlosole in somites xviii to xxiii, or thereabout.

Epithelial cells of the alimentary canal surround glands of various forms. In the epithelial lining of the gizzard we find club-like glands (fig. 21 *gl.*) consisting each of one (seldom of more) large cell with round nucleus, a narrow duct reaching between the epithelial cells, and ending with a large chamber, in very much the same way as the pharyngeal and septal glands.

In the narrow thin walled part between the two gizzards I find a few clusters of glands (?) similar to those I have described in Argilophilus. At the bottom of the cluster we find a glandular cell, upon which are butting the peculiar lunate cells, which again surround a lumen, which is much wider than in the corresponding organ in Argilophilus (fig. 22 *gl.* and *c.*) The lining of the sacculated intestine and the typhlosole are composed of three distinct kinds of cells, two of which are glandular (figs. 24 and 25.) The common epithelial cells offer nothing of particular interest. The glandular cells are of two distinct kinds (fig. 25). One kind is the one most common in oligochæta (fig. 25 *gl.*) and its enclosed granules are much smaller. The other kind is probably identical with the T-shaped cells described by Benham in Eminiodrilus, though the T-shaped form is not quite so prominent. The granulation is coarse and highly refractive and the distal part of the cell stains intensely, especially with methyl green. The other or first mentioned glands remain at the same time unaffected by this stain. These dark staining cells are much less numerous than the other kind, and are scattered about in a rather regular way. Fig. 24 *b* represents one of the lobes of the typhlosole, showing the absence of glands at the apex as well as the general distribution of the dark staining cells.

Calciferous diverticula. I found in the two specimens dissected and sectioned only two pairs of calciferous glands in somites xv and xvi, but I am unable to say if this will be found constant, as all other species of Benhamia possess three pairs of calciferous pockets, which Beddard claims are characteristic of this genus. Michaelsen's observation that the two diverticula are of different nature is confirmed here, as in the posterior pair no lime crystals were found, either in this or in the other species described below. Also the histological structure of the posterior and anterior diverticula is distinct. The nuclei of the anterior pair are round while those of the posterior pair are more oval, and the cells of the latter pair are not separated by distinct walls. They contain also numerous vacuoles or bladder-like bodies, some of which deatch themselves from the main body of the organ.

Figures 27 and 28 represent the anterior pair, 29 and 30 the posterior pair of calciferous diverticula seen respectively under high and low power. The posterior pairs only were found covered by chloragogen cells. These differences in structure I also found in the calciferous diverticula of the following species: *Benhamia palmicola* and *rugosa*, and they probably hold good with all the species of Benhamia.

Typhlosole exists in somites xvii or xviii to xxii, and is greatly developed as regards length, width and depth (figs. 7 and 14). It is widest and deepest in somite xix, tapering or diminishing both anteriorly and posteriorly. In the following species the typhlosole is much smaller.

Spermathecæ. The two pairs as usual in vii–viii and viii–ix. The form of the spermatheca and its diverticula may be best understood from the figures 34 and 35. The pores come rather close together in a general groove below the ventral ganglion. There is a muscular and a glandular part, and the spermatozoa were fonnd as usual principally in the diverticula.

Spermducts and rosettes. The only peculiarity of the spermducts is that they are thickened in somites xviii, xvii and xvi. In xv the duct narrows, and continues forward, with about half the thickness it possesses in the above posterior somites. The thickening is due to an increase of a circular muscular layer (figs. 7, 11, 12, 13, 36, 37). The rosettes are in x, xi, as usual.

Prostates. The usual two pairs are in xvii and xix. The lower part is long, slender and muscular, while the upper thicker part is glandular. This glandular part consists of only one layer of cells, covered by a thin epithelium. The glandular cells are of different length, as shown in fig. 32. The muscular part consists mainly of a thick layer of circular muscles (fig. 36), lined by a very thin layer of interior epithelial cells (fig. 38).

Penial setæ. A sac with two penial setæ open jointly with each prostate. At least one of the setæ is sculptured as shown in the figures 31 and 33, with a number of bristles, 12 or more. The smaller seta was broken in all the specimens, and I could not ascertain if it was sculptured or not.

Nephridia. Benhamia nana belongs to a group in which the nephridia are arranged in three rows on either side of the median line. There is not a diffuse nephridic condition, but each nephridium is well developed, and upon the same principle as the mega-nephridia of Acanthodrilus. Nephridia *a. b.* are ventral and in front of setæ 3 and 4, while the other nephridium *c.*, is lateral and partly dorsal. The posterior nephridial ducts, from xvii to xviii, are superposed each on a large oval sac of cœlomic cells, while those in front of the male-pore are not furnished with any cœlomic mantle. Of the anterior nephridia those in the genital somites are somewhat smaller than those in the vicinity of the pharynx, the increase in size forward being gradual. Blood capillaries are found in great numbers on all the nephridia, but especially so on the posterior ones. The general structure of the nephridial canals and their windings resembles those of fully developed mega-nephridia (figs. 39, 40, 41), but the smallness of these organs prevented me from definitely ascertaining the relative size and structure of all the canals. The canal leading to the outlet duct is strongly ciliated. Fig. 41, which represents the inner part of one of the anterior nephridia is held somewhat diagrammatic, as the respective thicknesses of the canals could not be properly delineated. I believe the most anterior nephridia are found in iii, in which somite they are very large, crowding each other.

Benhamia palmicola n. subsp.

Figs. 43–55.

Habitat. Miraflores, in the Cape Region of Baja California, some 40 miles north of San José del Cabo; also around Tepic, territory of Tepic, on the Pacific Coast of Mexico. The altitude of Miraflores is about 1,000 feet, while that of the City of Tepic is about 4,000. Probably the species does not descend to the hot lowlands of the coast belt, at least no specimens have been found either at San José del Cabo or at San Blas.

Color. The specimens are pink flesh, much less opaque than *B. nana*, no pigment cells.

General Remarks. For the present I arrange this as a subspecies under *B. Bolavi*, from which it differs in several points of considerable importance. These are the different form of spermathecæ, the situation of the first dorsal pore, the different sculpture of the largest penial seta, the location of the gizzard, the number of sperm-sacs, etc.

EXTERIOR CHARACTERS.

Size 50 to 60 mm.

Somites 110.

Clitellum incomplete in all somites xiii–xx.

Dorsal pores, most anterior one between iv–v.

Spermathecal pores in line with setæ 1 and 2, between vii/viii and viii/ix.

Oviducal pore. One central median oviducal pore in xiv.

Penial setæ, two in each sac. The longer seta has apex curved and furnished with four blunt, bristle-like crenulations. The smaller seta has the point slightly forked, one prong being longer, and a thin membrane extended between the two forks.

Common setæ. About equal distance between the dorsal and ventral couples as between the ventral couples.

INTERNAL CHARACTERS.

Buccal cavity with a dorsal pocket of sense organs and glandular cells.

Pharynx not situated far forward.

Gizzards both apparently in viii.

Calciferous diverticula, 3 pairs in xv, xvi and xviii.

Septal glands, small in ix and x.

Typhlosole small.

Sperm-sacs in xi and xii.

Spermducts not thickened in the somites near the pores.

Prostates are larger than in *B. nana*, but mostly confined to one somite each.

Spermathecæ in vii–viii and viii–ix. The two divisions are of equal size, and globular; small tubercular diverticle pointing forwards.

Nephridia in three distinct rows on either side of the median line. Nephridium *a* nearest the ventral ganglion consists of two unequal parts, the most ventral of which is the smallest. These two parts together are much larger than either of the other two nephridia. The dorsal nephridia are far apart.

DETAILED DESCRIPTION.

Body-wall and sense organs. We find the same zone of sense organs in the body-walls as in *B. nana*. In *B. palmicola* this zone is found in all the somites, while in *B. nana* I found none in somite i.

The sense-organ zone with pellucid cubic cells is in this species larger than in *B. nana*, and stands out most prominently on the upper side of the buccal cavity.

Septal glands. As has already been stated small septal glands are found in somites ix and x or posterior to the gizzard. These glandular masses are quite small, are situated in the anterior part of the somite, close to the intestine, but hardly projecting above the latter. I cannot find that they are in anyway connected with the pharyngeal system of glands.

Intestine, etc. The portion of the pharynx is not far forward. The region of its epithelial columnar cells is thick and the discharge chambers of the pharyngeal glands are tubular, instead of globular as in *B. nana*. The pharyngeal glandular mass is less lobed than in *B. nana*.

The region between somite i and pharynx is much longer in *B. palmicola* than in *nana*. The specimen sectioned longitudinally showed the two gizzards as both situated in viii, and there was no septum separating them. If this character is constant is undecided as I did not wish to sacrifice another specimen. The tubular intestine is long and cylindrical and furnished with the regular three pairs of calciferous diverticula in somites xv, xvi, xvii. No lime crystals in the posterior pair. The sacculated intestine commences in xviii or xix. The typhlosole is smaller than in *B. nana*, but owing to sand I could not definitely ascertain its location.

Spermathecæ. The four spermathecæ are of the same form and size. The contraction at the center is deep, dividing the organ in two equal, globular sacs, each sac being confined to one somite; that is, the apical part is situated entirely in the somite posterior to the pore. The basal part carries a short narrow cylindrical and tubular diverticulum pointing forwards. The equality in size and the globular form of the two parts of the spermatheca appears very constant and characteristic of the species.

Sperm-sacs are sac-like, not racemose. They are found in xi and xii, while in *B. nana* they are placed in x and xi.

Spermducts are considerably thickened, but the lower part is not any thicker than the upper part, as in *B. nana.*

Gonads are affixed high up on the septum and not at the junction with septum and body-wall.

Prostates. These bodies are larger than in *B. nana*, but nevertheless generally confined to one somite each. The penial setæ are, as usual, of unequal size. The larger seta is furnished with four notches, the smaller is spoon-like and forked at the apex.

Nephridia. These organs are arranged in three distinct rows on either side of the median line, but the nephridia in each somite are of unequal size. The nephridium nearest the ventral ganglion or nephridium *a* consists of two, more or less, separate parts, evidently a tendency to diffusion or an imperfect centralization. The most ventral part is the smallest and the most distal the largest. The ducts run continuously between these parts, but the cœlomic cells are grouped in such a way that the bridges between the two parts are quite narrow. The nephrostome of nephridium *a* was always plain and readily seen, but I never succeeded in finding the nephrostomes of *b* and *c*. Still, these nephridia appear perfectly formed on the meganephric principle, and I could never see any connection by canals between *a* and *b*, and *b* and *c*, though sometimes the cœlomic cell masses extended more or less continuously over and between the respective nephridia *a*, *b* and *c*.

Nephridia *a* open in front of setæ 1 and 2, while in *B. nana* they open in front of 3 and 4. The most anterior nephridium possessing a cœlomic covering I found in xxi. Through the courtesy of Dr. Michaelsen, I have received specimens of *B. Bolavi* for comparison. The nephridium of *B. palmicola* resemble that of *B. Bolavi*, but is much larger, and the respective nephridia cover each other slightly, while in the two specimens of *B. Bolavi* which I dissected the respective nephridia were separated by considerable distance; the latter nephridia are also smaller. I had at first intended to assign these species of Benhamia possessing several nephridia of a perfect form under a separate subgenus, when my attention was called to the fact, by Dr. Michaelsen, that *B. Stuhlmanni* sometimes possessed a similar arrangement of nephridia as those in *B. Bolavi*, etc. As the nephridia of *B. Stuhlmanni* are generally plectonephric or diffuse, it became at once evident that this distinction could not be used as a generic character of value, and that it really is impossible to draw any distinct line between a plectonephric and a micronephric condition. It is, however, entirely incorrect to characterize these nephridia as a mass of tubules, etc., as wherever they are separated one from the other, as in *Bolavi*, *palmicola*, *nana*, *rugosa* and probably great many other species, each micronephridium is perfect in itself, and built on the same general principle as the meganephridia of the other terricolæ. I would therefore propose to make a distinction between plectonephidia, or really diffuse nephridia, and micronephridia, or nephridia of small size, but perfect, or built on the meganephric plan. Such a distinction may be useful in descriptions, even if they are not morphologically distinct.

Benhamia papillata n. sp.

Figs. 43 A, B, C, D, E; 52.

Habitat. Tepic, Territory of Tepic, 4000 feet; Mexico.

I am unable, on account of want of time, to add any detailed description to the short definition of this species given above. When I described *Benhamia palmicola* I possessed only a single specimen of *B. papillata*, and I supposed that the differences in the structure of some of the organs, as well as the presence of the prostate papillæ, were due exclusively to individual variation. But while this paper was being printed I became possessed of about twenty specimens from the same locality, all of which resemble each other in all the points referred to in the description, and I therefore do not hesitate now to assign to them a specific name, especially as I find that this species is much more distinct than I at first suspected. While it in many respects resembles *B. Bolavi*, it differs in other points which must be considered of specific importance. *B. papillata* differs thus from *B. Bolavi* in possessing four exterior tubercles, one for each prostate pore. The smaller penial seta in *B. Bolavi* is flat and somewhat forked, while in *B. papillata* the smallar seta is furnished with a sigmoid tip of exceeding thinnesss. The clitellum in *B. Bolavi* and *B. palmicola* is incomplete, but in *B. papillata* it is complete even on the ventral side, showing several rows of glandular cells, but the width of the layer of clitellar cells is much narrower in the central part. Clitellum is ventrally complete only in somites xiv, xv and xvi.

The following are the other points of interest as regards the character of this species: It is larger than *B. palmicola*. The four papillæ, each one of which carries a prostate pore, are very distinct and prominent, and they stand close together in the sunken genital pit of the clitellum. The median central papilla, on which open the ovipores, is elevated and oval. The two ovipores are situated in the center of the papilla, but entirely separate. They are in the very center of the somite and in a line drawn between setæ 1 and 1. In *B. palmicola* the ovipores join, and the common pore is situated somewhat in front of a line drawn between setæ 1 and 1. Longitudinal section of a specimen shows that the septum separating somites xiii/xiv is very much cupped, and the oviducal funnel is situated exactly above the central papilla in xiv and dips down straight to the ovipore. The anterior septæ are hardly thicker than the posterior ones, but they are all very much cupped. Sacculated intestine commences in xix. There is a strong superior typhlosole in xx to xiv. Of the three pairs of calciferous diverticula the anterior one in xv is very much, or about four times, smaller than each of the posterior ones. The glandular part of the prostate is folded and quite thick, but confined to one somite.

Penial setæ. The penial setæ are the most distinct character of this species, besides the tubercles of the prostate pores. In general shape the two setæ are much more slender than those of *B. palmicola*, and several times narrower at the apex. They are so thin that it required an oil-im. 1/12 to show their structure sufficiently to enable me to sketch it. The larger seta is slightly curved, gradually tapering from the root to the apex. The apex is much less curved than that of *B. Bolavi* or *B. palmicola*, and furnished with seven or eight shallow but still distinct notches. But the smaller seta differs entirely from that of the *B. Bolavi* group. Instead of being more or less distinctly forked and wider at the apex, as in those species, it is drawn out to an exceedingly thin hair-like point, which is sigmoid (fig. 43 *e*). In shape the seta is almost straight, with the two ends slightly curving.

The *papillæ* of the genital region are most characteristic. Each papilla forms the exterior apex of a prostate. With a low power lens these papillæ appear round, but under a higher power they appear rosette-like, and consist of two or three divisions, one on top of the other. The ventral part of segments xvii, xviii and xix, carrying the genital pores, is much contracted, and the papillæ appear as in a bunch. The distance between the male or spermaducal pore and the prostate papilla is just about the same as the base of the papilla.

In a section the structure of the oviducal median papilla appears to greatly resemble that of the tubercula pubertatis of Sparganophilus. I find there the same relatively large number of tall, narrow cells, radiating from the ovipore, but I cannot discern any sense cells.

The spermathecæ differ in shape from those of *B. palmicola*. The apical sac is not globular, but pointed and narrow, as represented in fig. 52 G and H.

The nephridia also differ some from those of *B. palmicola*. In this species the inner nephridium, or *a*, consists of two parts, each one with a cœlomic mantle separate from the other, but in *B. papillata* nephridium *a* consists of three distinct parts, each one with a cœlomic mantle. This, of course, refers only to the posterior nephridia; the anterior ones are not covered by cœlomic mantle.

Sperm-sacs in x and xi, not racemose. In other respects, as far as I can judge by a hasty examination, this form resembles *B. palmicola*.

Benhamia rugosa n. sp.

Figs. 56–63.

Habitat. Native habitat unknown. The eight specimens in my possession were found in the orchid house in the Golden Gate Park of San Francisco, California, under pots. Two were adult, two imperfectly developed, the others immature. July, 1895.

Color reddish flesh.

EXTERIOR CHARACTERS.

Size, 30 mm. by 1½ m.

Segments, 118. Cephalic lobe very long, pointed.

Clitellum incomplete.

Dorsal pore, most anterior v–vi.

Oviducal pore, one single in the median line in xiv.

Prostate pores, the anterior ones elevated on tubercles.

Penial setæ. Largest seta with five notches, smallest seta forked with prongs of equal size.

Common setæ. All ventral in four couples; the inner setæ are present in xviii.

INTERIOR CHARACTERS.

Gizzards, two in vii and viii.

Calciferous diverticula. Three pairs in xv, xvi and xvii.

Sacculated intestine commences in xviii.

Typhlosole present.

Prostates slender, confined each to one somite.

Spermathecæ. The apical part a trifle smaller than the basal. Both parts much flattened. A very small diverticulum pointing forwards.

Nephridia in four rows on either side of the median line. The posterior nephridia with cœlomic glandular mantle. Nephridia in each somite of about equal size. Nephridia *d* and *d* about equidistant as *a* and *a*. The most ventral part of nephridium *a* not covered by the mantle. The clitellar nephridia larger than those anterior to clitellum.

DETAILED DESCRIPTION.

Size. The specimens had been slowly killed and extended before hardening. All the specimens were curved backwards, thus with the dorsal line on the inner margin of the crescent, causing the male pores to be situated at the greatest bend on the outer margin of the crescent. Most terricolæ curve the opposite way.

Shape of segments. The first ten somites are very nearly of the same diameter in the direction from head to tail. Somites xi and xii are slightly narrower. The clitellum which comprises somites xiii to xx shows plainly the intersegmental grooves. The posterior somites are of a somewhat shorter diameter than xi and xii. All the anterior somites including the most posterior ones of the clitellum are sculptured by longitudinal furrows running in the diameter from head to tail. This corrugation is seen all around the body, and gives the anterior part of the worm a very marked appearance. The posterior somites show a fainter corrugation. All somites are 3-ringed, except those of the clitellum.

Prostomium is long and pointed and slightly curved upwards (figs. 57 and 58) and is a trifle longer than somite ii. In all the specimens but one, somite i, was nearly entirely retracted in the buccal cavity, and when viewed from the exterior only a short portion of its dorsal part could be seen (fig. 58) and the prostomium appeared as if projecting from somite ii. One specimen had somite i extended as figured in fig. 59. Dr. Michaelsen has remarked a somewhat similar retraction of somite i in *B. kafuruensis*. Spermathecal pores as usual, vii–viii and viii–ix.

Clitellum is narrower than the surrounding somites. It is strongly corrugated, especially at the anterior and posterior margins. The prostate pores are, as usual, in xvii and xix. The exterior part of the genital region is very characteristic. In young specimens the two prostate pores are connected by a deep furrow in the center of which is seen the slight depression for the male pore. In the two fully adult specimens, however, the two anterior prostate pores were each situated on a very large globular papilla, surrounded by a deep fossa; while no such papilla and fossa characterized the posterior pair of prostate pores. In fact, these posterior pores were not visible from the exterior and could only be ascertained by dissection and transparent light. Viewed from the exterior the clitellum appears incomplete.

Penial setæ. The longer seta is hooked at the apex and furnished with five notches on the inner side, very much as in *B. Bolavi.* The shorter seta is less curved and about $\frac{3}{4}$ as long as the larger setæ. It is not hooked and the free apex is slightly forked, each prong being of the same length. There is no flare or wing between the two prongs (figs. 60, 61 and 62).

Oviducts. Both open together in a central pore in the median line in xiv, very close to the groove between xiii–xiv. In the largest of the two adult specimens the ovipore was situated abnormally between xv and xvi.

Intestine and *glands.* A strong supra-pharyngeal gland as usual. Gizzard in vii and viii, separated by a thin wall, as in other species. Tubular intestine extends from gizzard to xvii, and is in xv, xvi and xvii furnished with the three pairs of calciferous diverticula, of which the two anterior ones are of different construction histologically just as in other species. The sacculated intestine commences in xviii. There is a typhlosole.

Spermathecæ. As usual, in vii and viii. Those in vii were slightly smaller, and entirely confined to their somite, while those in viii projected their distal part through the septum into ix. The distal part is only a little smaller than the other part. The spermatheca is much flattened. Seen from below it appears as in fig. 52 *m*, while seen from the side it looks as in fig. 52 *n*. The lower part is furnished with a very small diverticulum, pointing forwards. The duct leading to the pore is very short, almost not set off from the lower sac.

Oviducts are slender, tubular, with a small and narrow funnel.

Nephridia. Those posterior to xix are furnished with a cœlomic cell mantle of oval form, even and regular, and of the same size in the various nephridia. Posterior to xix we find four rows of nephridia on each side of the median line, the rows being regular and parallel. The most ventral nephridium or *a* is situated between the setæ couples 1 and 2 and 3 and 4. The other nephridia *b*, *c* and *d* are dorsal and lateral. The two dorsal nephridia *d* and *d* are about as equidistant as nephridia *a* and *a*, and much closer together than the dorsal nephridia of *B. nana*, *palmicola* and *Bolavi*, the three other species which I have examined. The more ventral part comprising the outlet duct, etc., of nephridium *a* is longer than the corresponding parts of the other nephridia, and not covered by the cœlomic mantle. The clitellar nephridia are larger and their ducts thicker than the other anterior nephridia. The nephridia anterior to clitellum are very small, except those in somites iv and v, where, as usual, the nephridial ducts are long. Each nephridium appears perfect, and built on the meganephric plan (fig. 63).

Benhamia rugosa is readily recognized and characterized by the large papillæ on which open the two anterior prostate pores, by the four rows of nephridia, by the forked smaller penial setæ, by the corrugation of the anterior somites, inclusive of clitellum, by the pointed prostomium, by the flattened spermathecæ.

Since this was written Rosa has described a new American Benhamia from

Paraguay, viz.: *B. octonephra*, which appears to resemble my *B. rugosa* in several points, especially in having four rows of nephridia on either side of the ventral median line, or eight parallel rows in all. But it also differs in several others, sufficiently to be arranged under separate species. *B. octonephra* has about 90 somites, *B. rugosa* about 118. *B. rugosa* possess penial setæ, which, as far as I can judge from Rosa's description are different from those of *B. octonephra.*

Unfortunately, the characteristics of Benhamia species must be founded on most minute characters, which cannot always be expressed in words, as long as so comparatively few species are known. Too few of these characters have been figured, and many have been entirely overlooked. The penial setæ, which are of the utmost importance as species characters, should be in all instances figured. They vary much less than do the spermathecæ, the shape of which is only approximately constant.

ACANTHODRILUS Perrier.

Out of thirty-five species of this genus, which have been described to date and recognized by Beddard, none have been found as far north as Central America or Mexico. The two new additions to the genus which I am able to describe below will therefore prove of considerable interest on account of their habitat so far north, while one of the species shows a combination of characters rarely met with in this genus.

DEFINITIONS OF SPECIES.

Acanthodrilus tamajusi n. sp.

DEFINITION. *Length 15 cm., width 1 cm. in thickest part in front of clitellum; number of somites about 218. Clitellum xiii to xx. First dorsal pore posterior to clitellum. Penial setæ ornamented, one seta only in each sac. Common setæ paired. Prostate pores each on a round papilla. Gizzard in v. Calciferous diverticula 3 pairs in vii, viii and ix. Saculated intestine commences in xiv. Typhlosole present. Spermatheca large sac-like, with a few small warty diverticula. Sperm-sacs not racemose, in ix, x, xi, xii. Prostates four, much folded, opening with penial setæ. Nephridia large, meganephridia, not alternate. Color reddish, partly pigmented. Habitat, Guatemala, lowlands.*

Acanthodrilus Vasliti n. sp.

DEFINITION. *Length 6 cm. by 2 mm. in the region of somite viii; number of somites 92. Prostomium distinct, divides somite 1 about ½. Clitellum unknown. First dorsal pore vii/viii; first large dorsal pore ix/x. Penial setæ absent; common setæ paired, 1 and 2 not present in xvii and xix. Prostate pores not on papilla; each pore a duplex one. Ovipores in front of setæ 1 and 2. Spermathecal pores in front of setæ 1 and 2, and between somites vii–viii, viii–ix. Spermiducal pores in xviii in line with setæ 1 and 2. Septa v to xii slightly thickened. Gizzard in v. Sacculated intestine in xv. No calciferous diverticula. Peritoneum covered with a single layer of very large glandular cells. Very large suprapharyngeal gland, and a very small subpharyngeal gland. Spermatheca long tubular in viii and ix, no diverticula. Prostates 8 in* *number, 2 and 2 opening close together in the prostate pore. Typhlosole. Nephridia large, meganephridia, not alternate, opening in front of setæ 3 and 4. Color milky white, no pigment. Habitat, Tepic, Mexico, 4000 feet altitude.*

Acanthodrilus tamajusi n. sp.

Figs. 87–96.

Habitat. Of this species I possess one adult and half a dozen young specimens, principally from Tamaju on the rio Polochic in Guatemala. The largest individual measures about 150 mm., but even this one did not have the clitellum perfectly developed, but was otherwise seemingly mature. One of the smaller specimens measuring only 70 mm. in length possessed a more perfect clitellum than the larger specimen. These specimens were found by myself several years ago in June and July on top of the ground after rain. It is probably a common species in tropical Guatemala. On account of imperfect preservation of the specimens, some histological details are wanting.

Color. Deep violet-brown and iridescent when alive. Skin pigmented strongly on the tail, slightly on anterior part, but only on the upper side in the two mature specimens. A large immature specimen possessed no pigment, and was of a grayish color, but there may be some doubt as to its belonging to this species.

Size. Largest specimen 15 cm. by about 1 cm. in front of clitellum. The specimen had not been extended and killed before being placed in alcohol and must therefore have been considerably longer.

Number of *somites* 218 about, those in front of clitellum much larger than those posterior to it.

First dorsal pore in the pigmented specimens only posterior to clitellum. In the unpigmented between vii and xiii.

Prostomium doubtful (injured), but appears to incompletely or not at all divide somite i.

Clitellum complete, xiii to ½xx.

Penial setæ. A sac with one penial seta at each prostate. This seta has numerous short rows of teeth, decreasing in number towards the apex. The seta is quite short, blunt at one end and broad, tapering gradually toward the apex which is slightly recurved. The whole seta is irregularly sickle-shaped. The teeth are on the concave side. One seta possessed four notches with short teeth also on the convex side posterior to the other, or about where the thickest part begins (figs. 93 A, B, C).

Common setæ strictly paired on ventral side of body. The distances between the couples about the same. The ventral couples of setæ are present near to the spermiducal or male pores. They are the ordinary form but slightly larger than the common setæ.

Oviducal pores in xiv situated somewhat nearer the median line than to the inner couples of setæ, and the distance between the pores is a trifle more than the distance between setæ 1 and 2 in the same somite.

Prostate pores situated each on a small papilla.

Gizzard is in v.

Calciferous diverticula, three pairs, one each in vii, viii and ix, all of the same structure.

Sacculated intestine commences in xix and furnished with a typhlosole.

Spermathecæ in viii and ix with a few warty diverticula, one of which is larger and furnished with two swellings. Spermathecal pores in front of setæ 1 and 2. The spermathecæ are large, filling the space between the septa on the ventral side of the body. No spermathecal copulary setæ.

Sperm-sacs sac-like, not racemose, occupying the whole space left in ix–xii.

Prostates much folded, opening with penial setæ; each prostate confined to one somite each, the free distal end pointing backwards, and situated close behind the male pore.

Nephridia, strictly meganephridia, not alternating.

DETAILED DESCRIPTION.

Each prostate pore is situated on a round globular papilla, between which and the male pore runs a copulatory fossa. In xvi and xx there is in each a copulatory ridge, running parallel with the intersegmental grooves and somewhat longer than the space between setæ 2 and 2 (fig. 91). There is a shorter ridge in xviii extending between the male pores.

The *prostomium* and somites i and ii are transversely sulcated, most so somites i and ii. Also somite iii shows this sulcation in a smaller degree. The anterior nine somites are more or less distinctly segmented in three parts, that is, they show a central ridge on which are situated the setæ. The following posterior somites show a segmentation in five parts. In the clitellium the segmentation is clear, as far as regards the intersegmental grooves, but the segmentation of the somites is not very distinct.

The *supra-pharyngeal glands* form a very large body, superposing the pharynx. It is rounded posteriorly, and consists of four larger and five smaller lobes, this when viewed in a longitudinal section just outside the median line (fig. 96).

The *calciferous* diverticula show all the same structure.

The *spermathecæ* are large, globular masses, as seen in figs. 94 and 95, with warty diverticula, one of which is much larger. The spermathecæ overlap each other and are bunched in a solid mass between the septa on the ventral side of the body.

Testes are in two pairs, quite or very small when viewed in sections—in x and xi, in front of the ciliated rosettes, on the posterior face of the anterior septa.

The *ciliated rosettes* or sperm-funnels are in xi and xii, and are very large, crimped and furnished with a wide muscular duct. The funnels in xii lie much higher up than the one in xi, much closer to the intestine. The posterior part of the funnel is very thick, and so is the duct. The ducts join and open as usual in xviii. The rosettes lie free, but are connected by connective tissue with the anterior septa. They thus point backwards.

The *body-wall* is very thick, and the longitudinal muscles are not bipinnately arranged. The septa between v, vi and so on until xi, xii, are much thickened, and thicker than the other, though the one between xi, xii is not as thick as the anterior ones. The gizzard is connected by several powerful muscular strands with the body-wall in xi.

There is a very large mass of *pepto-nephridial* tubes situated immediately above the posterior part of the pharyngeal gland. Longitudinal sections show the anterior nephridial canals to be greatly folded and very narrow. There are very large masses of free cœlomic cells situated in the somites containing the sperm-sacs and the funnels of the spermducts.

Acanthodrilus Vasliti n. sp.

Figs. 148–154.

General Remarks. This species is one of those abnormal forms which occur in almost every large genus, and whose organization and characteristics are not readily accounted for. It is also the most northern of any Acanthodrilus found so far, though undoubtedly true Acanthodrili will be found much further north. *Acanthodrilus Vasliti* differs from any other Acanthodrilus in possessing eight prostates or spermiducal glands, arranged in four pairs, two and two prostates opening together in each one of the four prostate pores in somites xviii and xx. Also in one other respect does this species show an interesting characteristic. The peritoneum lining the septa and body-wall is covered with enormous glandular cells, very much resembling those forming the nephridial mantle in many species. The duplication of the prostates is also found in *Kerria McDonaldi,* while abnormal development of peritoneal cells remind us of certain cœlomic organs found in Perichæta and some species of Acanthodrilus (Beddard, page 29, Monograph of Oligothæta). Four pairs of prostates have been described by Ude in *Geodrilus singularis,* but details are wanting.

Of the specimens in my possession one was sectioned longitudinally, two were dissected and afterwards sectioned vertically. None of the specimens were fully adult; the various generative organs were developed, but there was no trace of clitellum.

Habitat. Tepic, Territory of Tepic, Mexico, at 4000 feet altitude, in the moist ground immediately under decaying logs, in the shade of a stone-fence, about one mile north of the city. October, 1894, Eisen and Vaslit, col.

Color. Milky white, like an Enchytræus, without trace of pigment.

Size. Length 6 cm. by 2 mm. in the region of somite viii. Slightly tapering towards the tail, the end of which is thickened.

Number of somites 92 in the largest specimen, all of about the same size, except the last few caudal ones, which diminish in width towards the most posterior somite. All are smooth, the anterior ones with a faint trace of trisegmentation.

Dorsal pores. The most anterior one that is distinct is seen between ix–x. Between vii/viii and viii/ix there is respectively a much smaller but still distinct pore. The most anterior pore is thus between vii/viii.

Prostomium is distinct, dividing somite i about $\frac{1}{2}$. The anterior somites are more distinctly set than the others. A long narrow groove begins on the ventral median line between somites xvi and xviii, and extends backwards about 20 to 25 somites, then changes into a narrow keel. This in the largest specimen, all having been slowly killed and straightened out.

Clitellum unknown, all specimens being immature.

Genital pores. Two pairs of *spermathecal pores* between ix–viii and viii–vii, in front of the respective septa, the spermathecæ thus being in ix and viii. The pores are in line with setæ 1 and 2, but are not prominent. *Oviducal pores* are in front of setæ 1 and 2 between xii/xiv.

Prostate pores in two pairs in the center of somites xvii and xix, in line with setæ 1 and 2. But each pore is really a duplex of two joint pores, which are only separated at the very epidermis by a thin wall. Thus the two prostates of each couple run parallel through the body-wall, each one opening separately, but the pores being so closely joined that they appear almost as one. No setæ of any kind near these pores (figs. 151 and 152).

Spermiducal pores are seen in line with setæ 1 and 2, close posterior to the setæ, only visible by strong transmitted light. The genital region in my immature specimens did not show any particular structure with papillæ, etc. The median fossa already referred to causes these pores to be situated on a slight ridge, which was not marked off laterally. Close to each prostate pore on their ventral side is a small tubercula pubertatis, only visible in sections.

Penial setæ absent.

Common setæ. Strictly paired ventral and lateral; 3 and 4 being situated slightly ventral, below the horizontal line. Setæ 1 and 2 are missing in somites xvii and xix. In xviii the ventral setæ 1 and 2 are present, but do not differ from the other setæ, which are all plain and sigmoid.

Nephropores in front of setæ 3 and 4.

INTERNAL CHARACTERS.

Body-wall offers no prominent characteristics, except that the peritoneal layer is enormously developed in all somites posterior to xiii. Peritoneum is strongly vascular, but in addition to the usual small peritoneal cells we meet with a thick layer consisting of a single row of tall peritoneal cells of varying but fairly even height.

Peritoneal cells are in places as high as the other layers of the body-wall combined, while in other places they are shorter. Similar peritoneal cells cover also the septa, principally those posterior to xiii. The center of the septa bear as a rule the tallest cells (figs. 149 and 153). These cells show a round nucleus and a granulation which resembles that of chloragogen cells, but which does not stain deeply as does the one of the latter cells.

The hearts in x, xi and xii, as well as the septal glands in vii and viii, are also surrounded by similar cells. The dorsal blood vessel again is covered by regular chloragogen cells.

Septa. Those separating respectively somites v to xii are slightly thickened and very strongly cupped, but not covered by any peritoneal cells. The septa separating xii to xiv are less cupped, not thickened, but all covered by a few peritoneal cells. The septa posterior to somite xiv again are not much cupped, but each one is lined on each side by a single layer of very thick tall peritoneal cells (fig. 153).

Alimentary canal. *Pharynx* is furnished with a large upper chamber and is apparently only developed superiorly, although it possesses a small subpharyngeal gland close to the ventral nerve cord.

Œsophagus rises diagonally upwards and joins the single *gizzard* situated in v. The *tubular-intestine* extends to xiv. The *sacculated-intestine* commences in xv. There is a typhlosole in the dorsal wall of the intestine in xvi to xix. The typhlosole presents a network of fibres resembling in a general way the structure of a sponge. This typhlosole does, however, not descend into the canal, but partakes more of the nature of a wide continuous blood-sinus.

Salivary glands. The suprapharyngeal glands form a mass with five distinct lobes, of which the posterior one, as usual, is the largest and the anterior one the smallest (fig. 149). There is also a subpharyngeal gland very low but rather long (fig. 149). A thin but wide septal gland is found in vi, posterior to the gizzard, while smaller septal glands, which are principally developed ventrally are found in vii and viii.

Spermathecæ consist of two pairs of long and narrow organs in viii and ix opening in the intersegmental grooves between vi and viii and viii and ix. In my specimens they were probably rather undeveloped and did not show any trace of diverticula either externally or in the wall.

Testes are in x and xi and *ovaries* in xiii. The *oviduct* opens between the setæ and septum. *Spermiducal funnels* or rosettes are very small, thick and compact, and situated in x and xi. The *spermducts* run separately backwards between the longitudinal layer and peritoneum and open jointly on the center of xviii as usual.

Prostates are in four pairs as has been already stated, two and two opening in each pore in line with setæ 1 and 2, these setæ, however, not being present in these somites (fig. 150). The prostates showed no glandular part, the whole being muscular (fig. 154). They were very thin, tubular, the two prostates in each twin couple running entirely parallel and close together along the septa, as far as the line of setæ 3 and 4. A large part of this distance the muscular part is surrounded by regular peritoneal cells, not by the large glandular ones. Each prostate remains separate from the other and even their external pores, though situated close to each other, are not strictly joined, though they are surrounded by a common thicker lip (figs. 150 and 151). I have already referred to the duplication of prostates in one species of Kerria, otherwise it has not been found with certainty in Acanthodrilidæ. Some of the earliest described Acanthodrilides were, however, supposed to have a prostate and spermducts open jointly, and it does not seem unreasonable to suppose that in some case at least a duplicate prostate existed, and one was mistaken for a spermduct. This would be quite easily done in specimens poorly preserved, especially if the prostates should be entirely muscular as in *Acanthodrilus Vasliti*, in which species they are also very narrow and thin and not really wider than the spermducts of many forms. Ude, in describing *Geodrilus singularis* from Danville, Illinois, mentions as one of the generic characteristics four pairs of prostate glands, but does not describe nor figure these in detail. The only way I can understand the presence of four pairs of prostates opening into four pores, is that two and two prostates open together. But on the following page (70) we are told that there are two pairs of prostates in segments 18 to 22, which open in segments 17 and 19. The figure shows us four prostate pores. If the first statement is not a misprint, we would in *Geodrilus singularis* have an analogy similar to what we find in *Acanthodrilus Vasliti.* But Beddard states in his large monograph on Oligochæta that *Geodrilus singularis* is probably identical with *Diplocardia communis.* This could, of course, not be the case if the prostates were duplicated in the former.

Tubercula pubertatis. Although no large and prominent elevation in the genital region is found, I have, however, satisfied myself that a tubercula pubertatis is really present even in my undeveloped specimens. Adjoining the prostate pore is a small tubercle, consisting of some tall supporting cells surrounding a bundle of sense cells, the latter characterized by the usual long, oval nuclei. These nuclei are situated much deeper than they are in the sense cells of the epidermis or in the buccal cavity, and they are also narrower than those. Otherwise this organ shows a very great resemblance to those in Benhamia, except for the absence of the glandular refractive cells. At the base of the sense cells in the tubercle I find numerous smaller round nuclei, the relationship of which my sections do not fully explain. Numerous nerve fibrils are seen to connect with the sense cells. Although no clear glandular cells are seen around the sense-organ in the tubercle, it may be possible that some may develop later at the same time as the clitellar cells, none of my specimens possessing any.

Vascular system. The last heart is in xi. The dorsal vessel is single; no subneural vessel. A large blood sinus in xvi to xix inclusive.

Nephridia are strictly paired, opening in front of setæ 3 and 4. Those posterior to somite xiv are surrounded by large peritoneal cells, while those anterior to xv consisted of the usual narrow ducts, free of any cœlomic peritoneal cell mantle. Numerous blood vessels cover the nephridii. The most anterior nephridium is found in iii. No pepto-nephridium. The anterior nephridia gradually diminish in size towards the anterior part of the body.

ALEODRILUS n. gen.

Figs. 66 to 86.

DEFINITION. *Acanthodrilidæ. Paired meganephridia, not alternating. Prostate pores, two pairs; one pair in xx and one pair in xxii. Spermiducal pair of pores in xxi. No calciferous glands; no penial setæ. Two pairs of spermathecæ in viii and ix. Clitellum xiii–xx. Two gizzards.*

General remarks. I possess only one single specimen of this interesting oligochæta, collected at Ensenada de Todos Santos in the northern part of Baja California. My time for searching was very limited and the season unfavorable, and this will account for the want of specimens. The single specimen was found in the dry bed of the river south of town at a water-hole in the otherwise dry creek bottom sand. It occurred here with Deltania and Limnodrilus. The sand was merely moist on account of overlying rubbish and sacks. The species is undoubtedly a native one and the only Acanthodrilid found on the coast so far north in the open ground, and and on this account even of geographical interest. The intestine of the worm was gorged with the coarse white sand of the river bed. The anterior part of the worm was cut lengthwise, one-half dissected and the other half sectioned crosswise. The want of specimens made a full investigation impossible, though I believe none of the important points remains in doubt. I have no reason to believe the species is scarce, though probably it is sharing the fate with all native worms, that of being displaced by European importations. The species is dedicated to Professor W. S. Keyes, my companion in many travels in tropical Mexico.

Affinities. It is interesting to note that Aleodrilus shows considerable affinity to the only other North American genus of this family, viz.: Diplocardia. It resembled this genus by having two gizzards, no calciferous glands, meganephridia, no sacs with penial setæ. It resembles Benhamia in having two gizzards, etc., but it differs from these two, as well as from all other Acanthodrilidæ, by the far backward position of the prostate and spermiducal pores, these being in xx, xxi and xxii respectively, while all other genera of this family have these respective pores in xvii, xviii and xix. The genital male pores are thus in Aleodrilus pushed three somites further back. Considering these and some minor characters I believe I am justified in placing this worm in a new genus.

Aleodrilus Keyesi n. sp.

Definition. *Length 7 cm., by 5 mm. wide; number of somites 80. First dorsal pore viii–ix. Clitellum complete in anterior, incomplete in the posterior somites, ½xiii–½xx. No penial sacs and setæ. Common setæ paired, those of the inner couple closer than those of the outer couple. Spermathecal pores between vii/viii and viii/ix. Gizzards in v and vi. No calciferous glands. Nephridia not covered by a cœlomic mantle. Nephropores outside of setæ 4. Hearts in x, xi, xii. Sperm-sacs racemose in x, xi, xii. Testes in x, xi. Color pale flesh, no pigment. Habitat, Northern Baja California, at Ensenada de Todos Santos.*

EXTERNAL CHARACTERS.

Color is very pale, mottled and marbled, showing clearly the intestines and blood vessels. When collected this worm resembled in delicacy of color and transparency *Deltania elegans* and I supposed it to be this species. *Spermathecal pores* are separate in front of setæ 1 and 2 between vii/viii and viii/ix. *Setæ* are ventral and lateral, 8 in each somite approached in couples. The setæ of the inner couple is closer than those of the outer couple. The distance between the couples is about twice as large as the distance between setæ 1 and 2, and one and one-half as wide as the distance between setæ 3 and 4. No penial setæ in special sacs. All setæ are sigmoid without sculpture. The anterior five somites are two-ringed, that is with a single groove in the equatorial region, while all the following somites are four-ringed, or with two parallel grooves in the equatorial region. The posterior somites are very wide and four-ringed, but the segmentation is irregular.

Ovipore a little interior to seta 1; nephropores outside of seta 4.

INTERIOR CHARACTERS.

Body-wall. There is a special zone of sense organs in the anterior somites as in Benhamia, but they are more scattered than in this genus. The longitudinal muscles run irregularly, with no trace of bipinnate arrangement. The strands are rather narrow. The longitudinal layer is very narrow, especially in the clitellum. The transverse layer consists of only 3 to 4 strands. The hypodermis offers nothing of special interest.

The longitudinal layer in the clitellum is greatly diminished in thickness, most so in the lateral and dorsal region of the clitellum. Anteriorly in somites ii and iii, the longitudinal strands leave the body-wall and spread out fan-shaped to the inner wall of the prostomium, forming retractor muscles for the upper and lower lips.

Arciform muscles. In somites xx, xxi and xxii we find on each side of the ventral nerve-chord several oblique or aciform muscles, running from the region of the copulatory grooves to the region above the lateral setæ, thus serving to depress and relax the two grooves. These muscles are confined to a single row, and do not show a complex arrangement, as is so frequently shown in oligochæta.

Septa. The septa between somites vii and xiv are much thicker than the others, especially thickened are those separating somites from vii to x. Those between x and xiii are less thick than the anterior ones. The thickest septa, vii/viii, viii/ix, ix/x, are much thicker than the body-wall. The most anterior thick septum is the one which posteriorly bounds the gizzard (fig. 74).

The septum next anterior to this, the one which separates the two gizzards, presents the peculiarity of not being attached to the body-wall, between vi and vii, but it extends forward parallel with the intestine and passes in front of the brain on the upper side, while the ventral side is attached to the œsophagus below the pharynx. It forms thus a sac, as in various species of Benhamia. Anterior to this septum I find no trace of others.

Alimentary canal. The pharynx is well developed and superposed by a very large glandular mass, which consists of about six layers of lobes, attached to muscular strands, as usual. The most posterior mass is the thickest. The discharge pockets of these glands into the pharynx are much thicker than any I have seen in other species, but are otherwise not of any characteristic construction.

Septal glands are situated far back in somites vii to xi. They are of the same nature as those which discharge in the pharynx, but I have good reasons to believe that the glands in this species discharge in the tubular intestine. I have been able to follow the discharge duct as far as to the muscular layers of the intestine, which would hardly have been the case if the ducts had continued forwards into the pharynx, as do those of the forward septal glands in many genera. A peculiarity of these glands is that they are especially developed on the ventral side of the intestine (fig. 75) and are distinctly paired. On the median line below the intestine the ends of each glandular mass meet and join into one duct, the one I have just referred to. The free ends of the glandular masses are attached by mesenteric tissue to the ventral or subintestinal blood trunk.

A much smaller tubular gland of the same nature runs between the dorsal vessel and the intestine; discharge duct unobserved. A yet smaller gland is seen above the subventral vessel in the same somite as the former; its discharge duct could not be followed.

These glands stain exactly as the common supra-pharyngeal glands and septal glands, but they show no similarity as regards reagents with the chloragogic cells of the intestine and blood vessels, in corresponding places in the somites posterior to xi. The septal glands appear to be of about equal size, a close examination being impossible, from want of sufficient material.

Other glands are found in the epithelial walls of the intestine, arranged in clusters, like the cloves in a garlic. They are scattered about at short intervals among the epithelial cells, and appear of the same nature as those I have described in Argilophilus, but they are not as numerous as in that species. They do not stain freely, but stand out bright and pellucid among the darker staining cells.

Typhlosole not present.

Gizzards are connected by a very thin wall of the same nature as the œsophagus. As far as I can make out the gizzard must be in v and vi, at least the posterior gizzard is bound by the septum separating vi and vii. The circular muscular layer is about 30 strands wide, and is at the widest place about four times thicker than the epithelial layer and cuticle together. The whole width of the gizzard wall is little more than twice that of the body-wall in that somite. The longitudinal muscular layer of the gizzard is only one single strand thick, and the thickness of this strand is less than any one strand of the circular layer of the gizzard. The epithelial layer is comparatively thick, about one-fifth of the whole gizzard. It contains the same peculiar glands as I figured in Benhamia.

Spermathecæ. The absence of diverticula is interesting in as much as most species of related genera possess them. There are, however, some warty elevations. The muscular or basal duct is very long, slender and tubular, several times longer than the upper ovoid sac (fig. 74). The muscular part offers no peculiarities of structure. The spermathecæ occupy each only one somite. They stand upright following close to the anterior surface of the septum.

Testes are greatly lobed and are situated high up on the septum, just as are the ovaries.

Spermducts and ciliated rosettes. The spermducts are separated, but enclosed in a common muscular sheath until somite xxi is reached. Between xx and xvi the two ducts fuse into one lumen, which opens out into the center of somite xxi. The double lumen runs along the circular muscular layer forward until somite xiii/xii, when the respective ducts rise upwards following the septum to the ovary and testes. From here on forward each duct is thicker and muscular, and instead of following the body-wall passes straight through the cœlomic cavity to the anterior septa, which they pierce immediately at the base of the ovaries and testes (fig. 78). A double lumen is seen only after it passes posteriorly to the ovary. The rosettes are not large, but thick with a wide base; the latter is furnished, where it passes through the septum, with several small sac-like glands, each with a distinct lumen, which I followed through the muscular layer of the spermduct and which I suppose empties into the neck of the rosette (fig. 79). The rosettes are not enclosed in the sperm-sacs.

Sperm-sacs. The three pairs of sperm-sacs are racemose, but not exceedingly so. There are four or five large lobes of globular shape seen in every section suspended from the septum and on the under side of the intestine, though somewhat projecting above it. The two anterior sperm-sacs in x and xi are smaller than the posterior one in xii, the one in x being the smallest of the three pairs. Those in x and xi are suspended from the anterior septum separating x/xi and xi/xii. Of the position of the posterior sperm-sacs I am uncertain, but it appears suspended from the posterior septum, the one separating xii/xiii, as far as I can judge from a cross-section.

Spermatogonia. In the two anterior sperm-sacs the spermatogonia offered nothing peculiar as regards the development of the spermatozoa. There is in each sperm-sac a large central zone of peculiar cells, staining differently. They re situated very close together, and possessed in my preparation rather shrunken nuclei (figs. 63 and 75). This zone exists in all the various sperm-sacs in the anterior as well as in the posterior ones. The development of the spermatozoa in the two anterior pairs appeared entirely normal, the spermatogonia possessing the same form as in other species, the large nuclei standing out freely like beads above the wall. But in the posterior sperm-sacs the spermatogonia, one and all, looked quite differently. They were here of many varying sizes, some small, some enormously large, and the nuclei, instead of standing out from the wall of the spermatogonium, were always bunched in the center, or strung across it as a central band (75). In other spermatogonia the nuclei were arranged as in a ring along the cell walls, but without pushing out. When the nuclei were in the center there appeared always a row of large and small vacuoles along the cell-wall. I find two sizes of nuclei, the smaller being always less in number, and about four times smaller than the large nuclei. When counter-stained with orange, the larger nuclei give quickly up part of their hæmatoxylon, the smaller ones giving it up slowly and not at all. The cytoplasma of the spermatogonia presented a very strong polarity as regards its position, it being always massed towards the cell-wall nearest the central germinative area (fig. 63). A somewhat similar process of developing spermatogonia have been described by Vernon in the sperm cells of Bombyx. The central germinative cell in Bombyx appears to correspond with the central area or cell agglomeration in Aleodrilus, but I have seen no such budding out of the germ cells as figured by Vernon, but this may depend on the insufficient material at my command.

A large number of similar spermatogonia were found in very large numbers in nearly all the anterior somites, either loose in the cœlomic cavity, or in a peculiar tissue which fills much of the cœlomic cavity. This tissue consists of large, more or less connected cells, very much like the cœlomic glandular cells surrounding so many nephridia. These cell masses are more or less diffuse, and appear not distinctly connected with any of the interior organs of the body. Among these cells are found scattered about large masses of spermatogonia, all in about the same stage of development. There are also numerous small free cœlomic cells, such as found in all earthworms.

Nephridia. There is one pair of mega-nephridia in each somite. The nephridium is very large, projecting above the lateral line of the body. The nephropores—at least some of them—are seen outside of or more dorsal than setæ 4. The nephrostome again is as usually seen very near setæ 1. There are no glandular cœlomic mantles on any of the nephridia. The anterior fold is much wider then the posterior one. The windings are very deep and twisted, and the spur generally sigmoid. The outlet duct, which is tapering towards the pore, is much darker than the other ducts. Its prolongation into the anterior fold forms there the central wider canal, which is also darker than the other two. The canal in the bridge continues forwards and upwards through the anterior fold, and is there the posterior one of the three canals.

Vascular system. The ventral and dorsal longitudinal vessels are both single. There are connecting vessels in somites vii to xii. In x, xi and xii, these vessels are very large, and take the form of so-called hearts. Each heart consists of four or five links, increasing in thickness upwards. Between each two links there is a thick circular valve. Similar valves are seen also in the dorsal vessel at the junction with the hearts. At the base of some of the valves are seen two rows of very large cells, the nuclei of which are about 3 to 4 times larger than the nuclei in the valve cells (fig. 83). All the valves in the hearts point downwards or ventrally. There are no glandular cells in the vessels, such, for instance, as are found in Pontodrilus, etc.

Posterior to the hearts we find long, tubular connecting lateral vessels, between the dorsal and ventral trunks, in the anterior part of each somite. These vessels, one pair in each somite (fig. 86), are of even thickness throughout, but with two short knob-like diverticula, one above the other, about equal distances from each other and from the longitudinal vessels. Both the dorsal vessel, as well as the laterals, are thickly covered with cœlomic chloragogen cells of a yellowish opaque color. These cells do not cover the ventral longitudinal vessel. These lateral vessels contain no valves.

Each valve consists of several circular rings, each containing a number of muscular strands enclosed within a common membrane. In longitudinal sections of the vessel most of the nuclei lie parallel with each other, but the outside ones run as the periphery in a circle. The smaller valves consist each of only one such lobe (fig. 73*a*), while the large ones are composed of several (fig. 73*b*).

SPARGANOPHILUS Benham.

DEFINITION. *Aquatic oligochæta. Eight setæ in four couples. Prostomium not marked off from peristomium, but furnished with a superior pit. Few dorsal pores. Clitellum very large, from eight to twelve somites. No penial setæ. Spermathecæ in vii, viii and ix, from two to eight in each somite. Sperm-sacs in xi and xii, racemose. Specmduct always subepidermal. Male pore xviii/ix, or anterior part of xix. Prostates generally present in three or four pairs situated several somites posterior to the spermiducal pores. No gizzards, no calciferous diverticula, no typhlosole. Four pairs of hearts. Two pairs of lateral, longitudinal integumental vessels extending forward from somite xiv, not connecting anteriorly with the gut-wall and median trunks. Nephridia meganephric, commence in somite xii or xiii.*

Principal *species characters* are derived from the position of the setæ; number and shape of spermathecæ in each somite; lobulation of the sperm-sacs; course of the spermducts; shape and position of tubercula pubertatis, whether dorsal or ventral, to the male pore or spermduct; extent of clitellum; presence of a subpharyngeal integumental gland in iii; length of worm and number of somites, etc.

GENERAL REMARKS.

The first species belonging to this genus was described by Benham from the river Thames in England. Later, Frank Smith described another species from North America and it became doubtful, as first suggested by Benham, if the genus was originally an American or European one. The very restricted locality or habitat of the European species would indicate its probable importation from some other country, and when the American species was found it became almost certain that we had to search for the original home of this genus on the American continent. Already when Benham's paper was published I had in my possession specimens of this genus from Guatemala, California and the Central North American States, and there remained no doubt in my mind as to the native habitat of the genus. As it now stands we have seven species sufficiently well defined to be recognized and one more of which no detailed description can be had, but of which we know enough to be able to recognize it should it again be observed. Of these eight species then seven are American and one European, and everything points to the probability that the latter one is a lately imported species to England most likely from this country, as Benham originally supposed.

The species described here below are not of equal value as species as might be naturally inferred. Four of the species are well defined, which principally is due to better preserved and abundant material for study. These species are: *Sparganophilus tamesis*, *Eiseni*, *Benhami* and *Smithi*. Two are less well-known, due entirely to want of sufficient well preserved material. These species are *Sparganophilus carneus* and *guatemalensis*, both of which may prove only varities of *Sp. Benhami*. The remaining species *Sparganophilus sonomæ* may prove a variety of *Sparganophilus Smithi*, but just as such all the more interesting.

A point of unusual interest in this genus is the presence of prostates, or, as

Beddard calls them, spermiducal glands. These glands are, in Sparganophilus, situated much further from the male or spermiducal pores than in any other genus, apparently quite independent of the pores. They are also subject to considerable variation, in some species being three, in others four; in one species none. Of the same nature I consider the forward parietal pair of glands in somite iii of *Sparganophilus Eiseni*, and it seems not unlikely that originally this genus possessed many more pairs of spermiducal glands, perhaps one in every somite. This location of the spermiducal glands favors greatly Beddard's view that these glands were originally independent of the spermduct, and according to this view these glands are in Sparganophilus the most primitive of any. There is also much difference as to the development of these glands in the various species. Thus in *Sp. Benhami* the gland consists of two distinct parts and is both glandular and muscular, while in *Sp. Smithi* the muscular part is degenerate or undeveloped, the whole gland being very diminutive. Another point showing the primitive arrangement of the spermiducal glands is the absence of any copulatory setæ, the common setæ in their vicinity being unmodified.

There is no doubt that a large number of species of this genus will soon be found on the American continent, especially as specimens appear numerous and widely distributed. In Guatemala I found them everywhere in springs and lakes, and a hasty examination of live specimens satisfied me that there were among them about three species, characterized by the position of the hearts, whether in viii–xi, ix–xi, or x–xiii. Unfortunately my Guatemala collection was destroyed and only few specimens in poor condition remain.

In this connection I will also call attention to another species of Sparganophilus not described below, but found by me several years ago in the small lake known as Laguna Puerca, situated near the ocean at San Francisco, California, or in the same lake as I now find *Sparganophilus Smithi*. This species which I have since been unable to re-collect, although I have made repeated excursions to the place and dug at the identical spot, offered much of interest and was undoubtedly a different form from any now described below. It was much shorter and thicker, about 5 cm. long by 4 mm. thick, or about half as long and twice as thick as our smallest species now known. The hearts were, according to a fieldnote, situated in vii, viii, ix, x. The longitudinal lateral vessels began in xiv, but most interesting of all, the species possessed five distinct and large eye spots on the first somite and prostomium, an occurrence not recorded in any other of the higher earthworms.

The specimens were very rare—I could only find two or three in an hour; they occurred in the clay soil near the shore at shallow depth.

In connection with this it is most interesting to note that at that time I found no trace of *Sparganophilus Smithi*, which now occurs in the same lake in countless numbers, a worm many times longer and much thinner. It is impossible that I could be mistaken in regard to my former observations. My explanation is this: Formerly the Laguna Puerca was much lower, the bottom soil near the surface was clayey, while now the lake is several feet higher, the bottom soil near the surface is sandy. A number of vegetable gardens have of late years been established at the headwaters along the creek furnishing the lake, and it is probable that *Sparganophilus Smithi* has been introduced with watercress, etc., from some other locality within the last few, say ten years, while the eye-bearing species may yet be living in the bottom soil.

KEY TO THE SPECIES OF SPARGANOPHILUS.

- I. Setæ 3 and 4 ventral; no prostates, spermducts dorsal to tubercula pubertatis. Sparganophilus tamesis Benham.
- II. Setæ 3 and 4 dorsal, prostates present, situated several somites posterior to the male pores.
  - A. A pair of ventrally situated parietal glands in somite iii. Spermducts and spermiducal pores dorsal to tubercula pubertatis. Sparganophilus Eiseni Smith.
  - B. No ventral parietal gland in any somite.
    - x. Spermiducal or male pore ventrally situated to the tubercula pubertatis.
      - a. 8 spermathecæ in each of somites vii, viii, ix. 2 ditto in vi. Sparganophilus Smithi n. sp.
      - b. 4 spermathecæ in each of somites vii, viii, ix. 2 ditto in vi. Sparganophilus sonomæ n. subsp.
    - xx. Spermiducal pore dorsally situated to tubercula pubertatis.
      - c. Spermathecæ trowel-shaped, outline crenulated. Sparganophilus Benhami n. sp.
      - d. Spermathecæ trowel-like, but outline smooth. Sparganophilus guatemalensis n. subsp.
    - xxx. Spermiducal pore unknown, but probably dorsal to tubercula pubertatis
      - e. Spermathecæ club-like, apical end globular, smooth. Sparganophilus carneus n. sp.

Sparganophilus tamesis Benham.

DEFINITION. *Length 7 to 10 cm. Clitellum 1-2 xv–1-2 xxv. Tubercula pubertatis xvii to xxii ventral to spermiducal pore. Setæ 3 and 4 ventral. Spermiducal pore between xviii and xix dorsal to tubercula pubertatis. Sperm-sacs in xi and xii minutely lobulate. Spermathecæ one pair in each of somites vii, viii, ix, ventral. No prostates. Anterior nephridium in xiii. Septal glands in v and vi. No subpharyngeal integumental gland. Blood capilaries on nephridia are numerous. Continuous blood sinus in the sacculated intestine. Hearts in viii, ix, x, xi, not filling the cœlom. Color pinkish with violet iridescence. Habitat, England, Thames.* Description is compiled after Benham's paper only, as I have not seen any specimens.

Sparganophilus Eiseni Smith.

DEFINITION. *Length 18 to 20 cm.; width 26 cm. Clitellum dorsally 1-4 xv–xxv, ventrally 1-2 xiv–xxvi. Tubercula pubertatis 1-2 xvii–1-2 xxii, ventral spermathecal pores. Setæ 3 and 4 dorsal. Spermiducal pore in anterior part of xix, dorsal to tubercula pubertatis. Sperm-sacs minutely lobulate. Spermathecæ, one pair each in vii, viii and ix, all dorsal. Prostates 4 pairs in xxiii–xvi; muscular duct present. Anterior nephridia commence in xiii. Septal glands in iv, v, about the same size, while the one in vi is very small. A subpharyngeal parietal pair of glands present, opening in front of setæ 1 and 2 in somite iii. Blood capillaries on nephridia are many. Continuous blood sinus in sacculated intestine present. Hearts in viii, ix, x, xi small. Color violet flesh. Habitat, Illinois, North America.*

Prof. Frank Smith has kindly sent me for comparison a full set of sections of this species, also several mature specimens in alcohol and formalin. As, however, Prof. Smith writes me that he intends to further work out the details of the anatomy and histology of this species, I have not considered myself at liberty to more than touch upon a few essential points of importance in further characterizing this species from its other American allies. The species is nearest related to *Sp. Benhami* and its subspecies. The main points of difference and similarity may be found in the comparative table of the species of Sparganophilus. *Sp. Benhami* is a much more slender form than *Sp. Eiseni*, especially as regards the body posterior to clitellum. The ventral side of the genital regions in the two species differ. Thus in *Sp. Benhami* the ventral depressed area between the tubercula pubertatis and the oviducal pores is circular or oval, while in *Sp. Eiseni* it is contracted in the middle, the shape of a sand time-glass. The presence of a small parietal gland in somite iii in *Sp. Eiseni* distinguishes this species from all others known so far. This gland is paired, extends considerably into the cœlomic cavity, is racemose and opens to the exterior in front setæ 1 and 2, and projects its free apex back through septum into iv. Another character is the small size of the septal glands in vi, the corresponding pair in *Sp. Benhami* being larger.

Sparganophilus Smithi n. sp.

DEFINITION. *Length 20 cm. by 3 1-2 mm. wide; number of somites 185. Dorsal pores, the most anterior one between i/ii, the most posterior one between xii/xiii. Clitellum dorsally 1-2 xvi–xxviii, ventrally xix–xxv. Tubercula pubertatis xix–xxvii, dorsal to spermiducal pores. Setæ 3 and 4 dorsal. Spermiducal pore between xviii/xix, ventral of tubercula pubertatis. Sperm-sacs in xi and xii. Spermathecæ 4 pairs in each of somites vii, viii, ix, and 1 pair in somite vi, slender, dorsal and lateral. Prostates 3 pairs in xxii, xxiii/xxiv. No muscular duct. Anterior nephridium xvi. Septal glands in iv, v, vi and vii about equal in size. No subpharyngeal parietul gland. Blood capillaries on nephridia numerous. Blood sinus in sacculated intestine not continuous. Hearts in viii, ix, x, xi, small. Color violet flesh, somewhat iridescent. Habitat, San Francisco, California.*

Sparganophilus sonomæ n. subsp.

DEFINITION. *Length 20 cm. by 3 1-2 mm. wide; number of somites about 200. Dorsal pores. Clitellum dorsally xvii–xxviii, ventrally xvi–xxix. Tubercula pubertatis xix–xxviii, dorsal to spermiducal pore. Setæ 3 and 4 dorsal. Spermiducal pores between xviii/xix, ventral of tubercula pubertatis. Sperm-sacs in xi and xii. Spermathecæ, two pairs in each of vii, viii, ix; one pair in vi, not slender. Prostates 3 pairs in xxiii, xxiv, xxv, no muscular duct. Anterior nephridium in xvi. Septal glands in iv, v, vi, vii, about equal in size. No subpharyngeal parietal gland. Blood capillaries on nephridia numerous. Blood sinus in sacculated intestine not continuous. Hearts in viii, ix, x, xi, small. Color violet flesh, less iridescent than Sp. Smithi. Habitat, Sebastopol, Sonoma County, California.*

Sparganophilus Benhami n. sp.

DEFINITION. *Length 17 cm. by 2 1-2 mm. in the posterior part of the clitellum; namber of somites about 250. No dorsal pores. Clitellum, dorsally xv–xxiv; ventrally xvii–xxvi. Tubercula pubertatis xviii–xxii, ventral to spermiducal pores. Setæ 3 and 4*

Table B.

Habitat
Length and width
Setæ 3 and 4
Clitellum
Tubercula pubertatis
Spermiducal pore
Spermathecæ
Sperm-sacs
Prostates
Anterior nephridia commence in
Septal glands in
Parietal cœlomic gland in iii
Blood sinus in the sacculated intestine
Hearts
Capillaries on the nephridia and in the body-wall

are dorsal. Spermiducal pore on anterior part of xix. Sperm-sacs in xi and xii, not minutely lobulate. Spermathecæ one pair in each of vii, viii and ix are dorsal. Spermiducal glands or prostates 4 pairs in xxiii–xxvi, with a long muscular duct. Most anterior nephridium in xii. Septal glands in iv, v, vi of about equal size. A pair of subpharyngeal parietal glands not present. Blood capillaries on nephridia few. A continuous blood sinus in sacculated intestine. Blood glands many. Hearts in viii, ix, x, xi. Color violet, strongly iridescent. Habitat, Tepic, Mexico, 4000 feet.

Sparganophilus guatemalensis n. subsp.

DEFINITION. *Length 10 cm. by 1 1-2 mm. wide; number of somites 260. Dorsal pores none. Clitellum xvi–xxvi. Tubercula pubertatis xviii–xxii, parallel ridges. Setæ 3 and 4 dorsal. Spermiducal pores unknown. Prostates four pairs in xxiv, xxv, xxvi, xxvii. Spermathecæ one pair each in vii, viii, ix; wide free end, wide, flat, outline smooth. Hearts very strong. Color deep bluish violet iridescence. Habitat, Guatemala City.*

Sparganophilus carneus n. subsp.

DEFINITION. *Length 9 cm. by 2 mm. wide; number of somites 160. Clitellum dorsally 1-2xv–xxv. Tubercula pubertatis unknown. Setæ 3 and 4 dorsal. Spermiducal pores unknown. Sperm-sacs in xi and xii, lobulate, but less minutely than in Sp. Eiseni. Spermathecæ one pair each in vii, viii, ix dorsal; free end globular. Prostates unknown. Septal glands in iv, v, vi, the one in vi the smallest. No subpharyngeal integumental glands. Blood capillaries enormously large and many in the anterior six somites. Hearts very large in viii, ix, x, xi. Color reddish flesh, much darker when in alcohol than Sp. Benhami. Habitat, Mississippi River, near Clayton, Iowa.*

After these preliminary definitions I will now describe in detail the various species of Sparganophilus examined by me.

Sparganophilus Smithi n. sp.

Figs 120–122, 124, 129–39.

Habitat. This species is very abundant in a small lake or pond known as Laguna Puerca and situated between Lake Merced and Golden Gate Park at San Francisco. Adult form in June to October, more frequent in the latter month. It occurs at or near, above and below the water's edge, the earth being thrown up in abundance and in heaps. I have already referred to nonpresence of this species some ten years ago in the above locality.

EXTERIOR CHARACTERS.

Color. A brownish flesh with violet reflex, but much less so than *Sp. Benhami* or *Sp. guatemalensis*. In alcohol this species becomes much paler than either of the two just referred to, almost pure white, looses its irridescence entirely. In formalin the color is pale, the irridescence very faint, strongest on the clitellum, and hardly perceptible on any other part of the body.

Length varies some, but generally reaches in fully grown and largest specimens 20 cm., while the width is about 3½ mm. posterior to clitellum. This and the following species are the longest forms so far known of the genus. The worms are not remarkably lively when out of the ground.

Setæ. The couple 3 and 4 are distinctly dorsal, and it may be of interest to note that in all species found in America the dorsal portion of these setæ appear characteristic, while in *Sp. tamesis* the setæ 3 and 4 are ventral or sublateral. I can find no character in the form of the setæ in the various species. They are all slightly sigmoid, slightly hooked and devoid of ornamentation. There are no penial setæ and no modified setæ in any part of the genital region. The setæ of *Sp. tamesis* as figured by Benham are more hooked than those of my new forms.

Prostomium and *pygidium.* I cannot find any good characters in the form of these part in the respective species. The small pit in the prostomium of *Sp. tamesis,* described by Benham, is found in all the species. The pygidium varies greatly. While some specimens have the anal orifice elevated and dorsal others have it central. The shape and size of the last somite varies also to such an extent that no species character can be derived from it. I will then in the following not refer to these part in any of the species described below.

Clitellum. In all the species of this genus the clitellum is very large, occupying from 8 to 13 somites. In *Sp. Smithi* it is located as follows: dorsally, ½xvi–½xxviii; ventrally, xix–xxv. Continuous all around the body. In all preserved specimens the body is bent towards the ventral side just at the clitellum, and special pains must be taken if a straight specimen is desired.

Tubercula pubertatis consists of a very elevated, continuous ridge, which is broken or depressed at the intersegmental grooves. It extends through somites xix–xxvii and is situated dorsally to the spermiducal duct and its pore. The ridge is further generally concave on the dorsal and convex on the ventral side. The ventral area between the two tubercula pubertatis ridges is thus much wider than in any of the other three new species described here. Anteriorly the tubercula pubertatis ridge is continued forward in a kind of semicircle which ends at the groove between somites ix/x. But these anterior ridges are much lower than the tubercula pubertatis proper, but nevertheless very sharply defined and distinct.

Spermiducal pore is situated between xix/xx, laterally to the setæ 1 and 2 and about three times as far from 2 as 2 is from 1. But the pore is ventral to the tubercula pubertatis ridge. This is an important characteristic and only shared with *Sp. sonoræ.* In *Sp. tamesis, Eiseni* and *Benhami,* the spermiducal pores are dorsal to the tubercula pubertatis ridge.

Oviducal pores are plain in front of setæ 1 and 2 on somite xiv.

Prostate pores externally not visible, but situated in front of setæ 1 and 2.

Somites. All the anterior somites are three-ringed, except i, ii, iii, which are smooth.

Dorsal pores. The most anterior pore is situated between i/ii, and the most posterior one between xii/xiii.

INTERIOR CHARACTERS.

Septa. Thickest septum is found between somites xi/xii. Anterior septa are gradually diminishing in thickness forward, and similarly the septa posterior to xi/xii are diminishing in thickness backwards. The most posterior thickened septum, the one between xiv/xv, is hardly thicker than the one next posterior. The central part of the thickened septa is very much thicker than the part near the body-wall. (fig. 127 *t.m.*) The septa correspond more to the intersegmental grooves than do those in *Sp. Benhami.* When the body is viewed in cross-section it will be seen that the septa are principally attached to the body-wall at four points nearly half way between the setæ (fig. 131).

Suprapharyngeal and septal glands. There are dorsal septal glands in iv, v, vi, vii, about equal in size, and ventral septal glands in v, vi, vii, also of about equal size. The latter are much larger than in *Sparganophilus Benhami,* and reach above the center of the body (fig. 120). In addition to these glands I find an accessory septal gland attached to the central anterior surface of septum ix/x, just above the intestine and extending downwards. This gland is closely attached at every point to the septum, and projects only slightly into the cœlomic cavity. In height this gland is not much thicker than the central part of the septum (fig. 132). Its free surface is very smooth and even. I could follow ducts with precipitated secretions running along the septum downwards towards the intestine, but its connection with the latter, if any, I could not ascertain. Beddard suggests that as the nephridia only commence in the thirteenth segments the septal glands described by Benham in *Sp. tamesis* are homologous with the nephridia. In all species of Sparganophilus investigated by me I find no such mucous glands as in Pontoscolex, only regular salivary glands, which open into the pharynx, and of the same structure as the supra-pharyngeal glands generally. These salivary glands in *Sp. tamesis* occur exactly in the same somites as in all other Sparganophilus species, viz.: iv, v and vi.

Body-wall offers no other characteristics, except that it is throughout of almost the same thickness, and not thinner along the dorsal parts of some of the central somites, as in *Sp. Benhami.*

Clitellum is continuous all around the body, but it is much thicker dorsally than ventrally. This thicker dorsal portion commences with the tubercula pubertatis, gradually increasing in thickness dorsally towards the median line, where it is four times thicker than at the ventral median line between the tubercula pubertatis. This refers only to the clitellar cells in the central clitellar somites. The long clitellar cells are confined to the latero-dorsal part, while the ventral part contains only the short clitellar cells, the point where the former cease being the tubercula pubertatis. This is the case in all the species examined by me.

Tubercula pubertatis. It has already been stated that they form a continuous ridge, only broken in the anterior two somites xvii and xviii. Their structure differs considerably from that of *Sparganophilus Benhami.* We find the tubercle cells less differentiated (fig. 138), and more resembling the short clitellar cells, of which they are only a variety. Another characteristic is the presence of a large blood vessel in the center of the tubercle. The most interesting feature, however, consists in the presence of three or four arciform muscular bands which connect the opposite sides of the tubercular projection, and which, of course, serve to further push out the [illegible] of the tubercle, or to relax it, as the occasion may demand. These bands are entirely confined to the clitellar cell layer, and penetrate to the very cuticle, to which at least some of the muscles are attached, while others seem attached to the cells themselves. Besides these epidermal arciform muscles, there are numerous cœlomic arciform muscles, which also penetrate the glandular layers and serve to connect the two sides of the clitellum on either side of the tubercula pubertatis (fig. 138). While the arciform muscles of the epidermal layer have been described by Cerfontaine in Lumbricus, they are by no means known from many species. Their presence varies considerably in different species of Sparganophilus, but they are especially numerous and strong in this one.

Œsophagus and intestine. As regards the general shape of the alimentary canal I can see no marked difference in the various species so far examined. Again as to structure I find two points worthy of mention. The chloragogen cells which are everywhere covering the intestine are much larger and more numerous in this species than in *Sp. Benhami*, covering as they do both tubular and sacculated intestine. Another point is the absence of a continuous blood-sinus. A continuous blood-sinus in the sacculated intestine has been described by Benham in *Sp. tamesis*, by Smith in *Sp. Eiseni* and is also found in *Sp. Benhami*, as will be recorded further on. In this species, *Sp. Smithi*, the sinus is not quite continuous, the respective blood lacunes are quite close and in places run together, but they are nowhere continuous in the same way as in the species referred to above. The sacculated intestine commences in xiii.

Spermatheca (fig. 130). The most characteristic feature of *Sparganophilus Smithi* is the occurrence of numerous spermathecæ in at least three somites, while in one somite there is found only one pair. Seven adult specimens from Laguna Puerca were opened and agreed in the following arrangement and number of spermathecæ:

Somite vi: 2 spermathecæ, in front of or slightly dorsal to setæ 3 and 4.

Somites vii, viii, ix: 8 spermathecæ in each, in front of, slightly dorsal and lateral of setæ 3 and 4.

The location of these spermathecæ is not strictly constant as in some specimens, as well as in some somites of the same specimen, the spermathecæ were shoved a little dorsally or ventrally of setæ 3 and 4. One specimen possessed three spermathecæ on one side and four on the other side in the same somite, but all the other specimens possessed eight spermathecæ in each of the somites, except in vi where invariably only one pair was found.

These spermathecæ are very large (fig. 125), tall and slender, and viewed in cross-sections of their body they are seen to extend from one end of the cœlom to the opposite side, touching both body-walls. They are generally directed forward and crowding each other; they occupy nearly all of the available room in the somite. I believe there is no other case known in oligochæta where so many and so large spermathecæ are known to occupy the same somite. The size of the respective spermathecæ varied some, but the general shape appeared quite constant within certain limits. The figures appended represent the spermathecæ taken from one specimen. There is a narrower muscular basal tube and a more swollen non-muscular chamber as usual, the structure of which offers no characteristics.

Sperm-sacs. Of the two pairs of sperm-sacs the anterior one in somite xi is much the narrowest in the direction of the median longitudinal diameter of the body. It is principally ventral in location, but extends upwards and joins the one from the opposite site. It is closely surrounded by a sperm reservoir without enclosing membrane. The sperm-sacs in xii are much broader and longer, but are generally only dorsal and do not enclose the intestine in any of the specimens sectioned. This relative size of the two pairs of sperm-sacs appeared constant. Somites ix and x are transformed into two very extended sperm reservoirs.

Ovaries in the various species are long and flat, not lobed, and in both longitudinal and transverse section offer to view a single undivided surface.

Oviducts are very broad and furnished each with an ovisac consisting of an invagination of the septum, which in all my specimens were filled with large gregarinæ, rarely containing any ova.

Ciliated rosettes are similar to those of *Sp. Benhami* in size. The spermducts run ventrally to as the tubercula pubertatis, about four times as far laterally and dorsally from seta 2, as 2 is distant from seta 1. The spermiducal pore is similarly situated ventrally to the tubercula pubertatis, This characteristic is in all the species only shared by *Sparganophilus sonomæ.* All other species are characterized by having the spermducts run dorsally as to the tubercula pubertatis. The spermiducal pore is similarly in *Sp. Smithi* situated ventrally to the tubercula pubertatis, and is found in the intersegmental groove between somites xix/xx.

Prostates or *spermiducal glands* (Beddard). There are three pairs of spermiducal glands, one pair each in somites xxii, xxiii, xxiv. One specimen possessed only one gland in xxiv, and there may possibly be found some variation in number when more specimens have been investigated. In all cases these glands were much smaller than in *Sparganophilus Benhami*, but otherwise almost similar in structure, except for the entire absence of the basal muscular duct. The glandular part was never large enough to be folded on itself lengthwise, but its tube was much twisted in the direction of its long diameter, often to such extent that cross-sections always showed the tube as three or four circular openings, surrounded by a wall two cells thick. The muscular basal part is absent, and the lower tube, where it enters the muscular layers, being very short, is surrounded by a thin layer of connective tissue. The whole organ in mature specimens projects only slightly above the body-wall, and the glandular part is in either diameter not any thicker than the body-wall.

Nephridia are in this species covered and perforated by numerous blood capillaries, to a much greater number than in *Sparganophilus Benhami*, but similar to what is described in *Sp. tamesis* and *Sp. Eiseni.* Otherwise the nephridia of the respective species appear to be of the same general size and structure.

Vascular system. The hearts begin in xi, and extend forwards to viii. In xii and xiii there are no connecting vessels. In xiv to xvii we find the dorsal vessel enlarged and folded on itself in a zigzag manner. Both hearts and dorsal vessels are thickly covered with chloragogen cells. I have already pointed out the absence of a continuous blood sinus in any of the various parts of the intestine. All the various organs of the body are thickly covered with blood capillaries, especially so the nephridia, spermathecæ, the clitellum, in which strong capillaries separate every two or three rows of the large clitellar cells. In the center of the tubercula pubertatis is always seen a dense mass of larger and smaller capillaries.

A characteristic of the vascular system is also the great scarcity of blood glands, these being very numerous in *Sp. Benhami.*

Sparganophilus sonomæ n. subsp.

Figs. 123, 126.

Habitat. Creeks and springs around Sebastopol, Sonoma County, California. Adult specimens very numerous in April.

General Remarks. I consider *Sparganophilus sonomæ* as probably a subspecies under *Sp. Smithi,* which it resembles in most points, two of which are of the greatest importance, viz.: The position of the spermduct and spermiducal pore, and the duplication of the spermathecæ in several somites. But as long as I found the number of spermathecæ constant, and some other minor points of difference, I thought it best to describe this form more carefully, leaving the question of species or subspecies as a matter of choice, and for future consideration and study.

EXTERNAL CHARACTERS.

Tubercula pubertatis are the only external organs which differ from *Sp. Smithi.* While in *Sp. Smithi* they form a continuous ridge on either side, they are in *Sp. sonomæ* broken up in numerous tubercles, generally two or three on each somite (fig. 123). I believe there is another characteristic worthy of mentioning. The single puberty groove is in the center of the tubercle, while in *Sp. Smithi* there are two grooves, one at the base on either side of the tubercle. But I freely confess that I have not sectioned up a sufficient number of specimens in order to know if these points are really constant, or if not rather they are subject to considerable variation. My supply of mature specimens of *Sp. sonomæ* was very limited, but in all I found the tubercula pubertatis broken into a succession of little knobs, but all together forming a ridge in outline like that of *Sp. Smithi.*

INTERIOR CHARACTERS.

Spermathecæ. While in all the specimens of *Sp. Smithi* I found eight spermathecæ in each of somites vii, viii, ix, the subspecies possess them as follows: *Sómite* vi: one pair with the pore in front of seta 4. *Somites* vii, viii, ix: two pairs (4) in each, with pores in front of setæ 4, and between 3 and 4. Each pair consists of two separate spermathecæ, one of which opens in the intersegmental groove in front of seta 4, while the other opens similarly in front of a line drawn $\frac{1}{3}$ the distance between setæ 3 and 4, the $\frac{1}{3}$ being towards 4 and the $\frac{2}{3}$ towards 3. Both pairs are, therefore, dorsal. The direction of the spermathecæ is in the diameter of head to tail. They lie closely pressed to the body-wall. As regards size, the most anterior pair is the smallest, and the most posterior the largest.

Sparganophilus Benhami n. sp.

Figs. 97–119.

Habitat.—In the mud of springs, October, November, 1894. Tepic City, Territory of Tepic, Mexico, 4000 feet altitude. Of some fifty specimens collected only three were well developed as regards clitellum and tubercula pubertatis.

EXTERIOR CHARACTERS.

Color, reddish-violet, very strongly iridescent. The violet tint is very pronounced, much more so than in any other species that I have examined except *Sp. guatemalensis*, where the bluish-violet tint is very deep and intense.

Body. This is a long and slender species tapering towards the tail end. The cephalic lobe is superiorly not distinct from somite i, but there is a small pit on the boundary between the two. Somites i, ii, iii are less prominent. Somites iv to ix are strongly convex, but x to xv are much less so. The clitellar intersegmental grooves are only distinct between the ventral setæ.

Dorsal pores. The most anterior dorsal pore is seen between i/ii; the most posterior one between v/vi. There is a central pit in the dorsal side of somites i, ii, iii.

Clitellum, as in other species; the extent of the clitellum is different on the dorsal and ventral sides. This I think can best be expressed thus: dorsally, ½xiv—xxiv; ventrally, xvii—xxvi. The clitellum is continuous, but much less developed ventrally between the tubercula pubertatis than dorsally. This is also characteristic of the other species I have examined. Viewing the clitellum exteriorly, it appears as discontinued between the tubercula pubertatis ridges.

Tubercula pubertatis begin in xviii and end in xxii. Each one consists of a straight ridge on the top of which runs a groove parallel to the ridge. Posterior to the tubercula pubertatis proper the ventral part of the clitellum is concave deepening posteriorly and ending in a deeper pit in the posterior part of xxvi. Anteriorly the tubercula pubertatis ridges continue forwards almost straight and outside of the ventral setæ 1 and 2 to the center of xii, where they end in the region of the ventral setæ. These two almost parallel ridges are very thin and sharp, several times narrower than the tubercula pubertatis proper. They only appear in fully adult specimens, and are very characteristic. I believe that the underside of the clitellum will furnish good species characteristics if carefully noted. But in order to bring out this region properly the specimens must be slowly killed and then as rapidly as possible be passed through the alcohols into that of 96%. Formalin specimens do not show the region as well as alcoholic specimens.

Male pore or spermiducal pore is situated on the anterior ½ of xx, just lateral to the tubercula pubertatis. The pore is not prominent, but may be readily seen.

Prostate pores are not prominent, but in adult specimens they may be seen in front of setæ 1 and 2 in somites xxiii, xxiv, xxv, xvi.

Ovipores are separate between somites xiii/xiv, or slightly on the anterior part of xiv.

Nephropores prominent in front of setæ 1 and 2 in all somites posterior to xii.

INTERIOR CHARACTERS.

Body-wall. In somites x to xiv the body-wall is much thinner on the dorsal side of the body than on the ventral side. As Benham does not mention this peculiarity in *Sp. tamesis*, and as I have not observed it in *Sp. Smithi*, I take it for granted that this character is peculiar to this species. The clitellum is complete, but much thinner on the ventral side between the setæ, as shown by figure 119, which represents the ventral body-wall in somite xix. It will be seen that the longitudinal muscular layer is several times thicker than the transverse layer. The strands are separated by irregular layers of granulated tissue of various thicknesses. The circular layer again consists of only one row of fascicles, each fascicle being tubular, and inclosing numerous irregularly distributed muscular fibers, strongly striate. When viewed in cross-section it becomes apparent that the strands of the longitudinal muscles are of varying thickness, the thicker ones being situated nearest the cœlomic cavity, from there gradually decrease in size towards the circular muscles.

Clitellar cells. The clitellar cells are especially interesting on account of their relationship to the cells of the tubercula pubertatis, which will be described later on. Figs. 107, 108 represent a longitudinal section of the body-wall in somites xxiii and xxiv. The muscular layers are much thinner, the clitellar cells are only developed in the vicinity of the prostates. Below the clitellar cells are seen long tubular cells, somewhat like those of the tubercula pubertatis, and between them are seen, now and then (fig. 107 *d.ch.*), the deeply staining discharge chambers of the clitellar cells. The unicellular glands, which are here very irregular, are entirely confined to the zone surrounding the intersegmental grooves. In fig. 108 is seen a more magnified part of the region close to the prostate. Only one unicellular gland, though of unusual size, is seen. It is a stray one, as they are rare in this particular zone. The structure of the clitellum of Sparganophilus has been well described by Benham in his paper on *Sparganophilus tamesis*, and I can only add a few points of interest. For studying the clitellar and tubercula pubertatis cells I have used principally the iron-lack Heidenhain process, but by adding a light tint of Ehrlich-Biondi to the ammonio-ferric-alum solution the most perfect differentiation may be had of the various clitellar elements. The clitellum in Sparganophilus contains the following various varieties of cells:

1. Regular epidermal cells, secreting the cuticle, furnished with oval nuclei. Even on the fully developed clitellum of *Sparganophilus Benhami* they occur all around, both on dorsal and ventral sides. Their inner ends are drawn out into one or more threads, some of which extend to the innermost margin of the epidermis (fig. 103, 1).

2. *Unicellular goblet* glands, entirely confined within the outer layer of the foregoing cells. They are very irregular as to size. These cells are the only ele-

ments in the clitellum which stain deeply with hæmatoxylin. These cells offer nothing characteristic of the species. They are the last to be affected by tropœolum and orange, their mucin remaining intensely blue. Their nuclei are compressed and placed in the posterior part of the cell in the triangular mass and extremity, staining black in the iron-lack (fig. 103, 2).

3. *Short club cells.* These are of very uniform size, their free ends forming a marked line all around the clitellum interior to the goblet cells. The free end of this cell is club-shaped and generally regular in outline. The heights of the individual cells are quite even, and, as these cells stain darker than the following kind, they form a marked contrast to all others. The granulation is coarse and regular, but does not stain readily with hæmatoxylin. It takes, however, deeply the red aniline stains. On the dorsal side of the clitellum these cells reach inward about $\frac{1}{3}$ of the whole width of the epithelium, while on the ventral side, they constitute the only so-called clitellar cells. The nuclei of these cells are oval and always prominent (fig. 103, 3).

4. The pre-eminently clitellar cells consist of several, 3 or 4, different lengths. This class of cells are in many genera, such as Lumbricus, etc., massed in columns, often very regular, and separated by septa. In Sparganophilus these cells are not arranged in columns, but distributed almost regularly all through the epidermis, of which they occupy about $\frac{2}{3}$ of the whole mass. At certain intervals, however, may be seen a thin triangular septa of connective tissue with nuclei, projecting downwards or outwards from the muscular layers, dividing this part of the epidermis in numerous irregular pyramidal masses, which latter are homologous with the columns in Lumbricus, etc. The nuclei of these clitellar cells are shrivelled up and situated far back in the triangular apex where the cellular plasma is especially agglomerated. There is no such granular secretion in this class as in the former, and they stain much less intensely than No. 3. These cells occur only dorsally to the tubercula pubertatis, and are entirely absent from the ventral side between the tubercula pubertatis.

5. Here and there we find intermediate varieties of oval and club-shaped cells longer and wider than the epidermal supporting cells and furnished with large round nuclei.

6. Connective tissue cells with large round nuclei, especially prominent between the circular muscular layer and the tall clitellar cells. At intervals this tissue forms triangular projections outwards, separating bunches of cells four or five wide and of different sizes. This tissue is generally accompanied by numerous capillaries.

Tubercula pubertatis. These organs are very prominent, and situated on a nearly continuous ridge occupying somites xviii–xxii. Benham has described this structure in detail in his species *Sp. tamesis*, and called attention to the fact that it is composed of long narrow cells, which are modified clitellar cells. In *Sparganophilus Benhami* these cells are of two kinds, as far as regards the form.

a Some which are very narrow, longer than the others, and narrowest at the free end. All of this class are grouped in such a way that they radiate outwards towards and around a small concave pit or groove in the outer edge of the epidermis (fig. 105).

b. Interior to these taller cells are shorter and thicker cells, indicated as *b* in the above figure.

Exterior to these, the regular and characteristic tubercula pubertatis cells proper are seen numerous unicellular glands, the same as the goblet cells of the epidermis.

In addition to these glandular cells, I find at certain intervals a few sense cells opening out into the narrow pit or groove just referred to. They are everywhere very few in number, tall, narrow, with now and then the tip projecting through the cuticle into the shallow pit (fig. 105 *s. c. l.*) There is not a continuous row of these cells, but here and there are found bunches of half a dozen cells, opening close together. They do not seem strictly parallel, but bulge and diverge in such a way that in sections, which show the common cells parallel, rarely more than one single sense cell is in view to any great part of its length. This, together with the small number of these cells, is undoubtedly the reason why they are frequently overlooked.

In connection with these sense organ cells, I have re-examined the ventral papillæ found in *Argilophilus marmoratus*, and I find that these structures are really nothing but tubercula pubertatis nature, or at least sense organs furnished with sense cells, a description of which will be deferred to a future paper. As a general conclusion, I may state that the tubercula pubertatis are really sense organs, furnished with sense cells of the same nature as those found in other parts of the epidermis, and described by me in Benhamia, and by Vejdovsky in Rhynchelmis, by Cerfontaine and Langdon in Lumbricus, by Hesse in Lumbricus and Allolobophora, etc.

Septa. The septa are not all of the same thickness, neither is each individual septum of the same thickness throughout. The first distinct septum is found between iv/v. It is of regulation thickness, or as thick as septum x/xi and those following posteriorly. The anterior septa increase in thickness forwards and backwards in such a way that septa vi/vii, vii/viii are of about equal thickness, while those in front and behind these are thinner in proportion as they are more distant. The anterior five septa are much thicker in their central area, and thin out towards the periphery and body-wall, but even then, at the thinnest part, they are about four times thicker than the posterior septa. The six anterior septa do not strictly correspond with the segments, but are attached to the body-wall about one-fifth the distance forward from the posterior intersegmental groove.

Suprapharyngeal and *septal glands.* The glandular mass superposed on the pharynx and opening into it, is prominent, but situated far back, and with its lobes pointing forward, or in the same direction as the septal glands. The opposite is generally the case, and has been so in all other species examined by me.

Longitudinal sections show that the regular septal glands are present in three somites. The most anterior pair is in iv, immediately behind the suprapharyngeal glands, and not separated from the latter by any septum. The other two pairs are in v and vi. In longitudinal sections the suprapharyngeal glands are seen to be composed of two distinct lobes of about equal size, one situated closely posterior to the other. This is also the structure of the septal glands in iv and v, but the one in vi is solid, consisting of only one lobe, when viewed in longitudinal section. The main lobes are situated on the same longitudinal muscular band, with their discharge ducts running forwards into the pharyngeal cavity. In each of the three somites there are two distinct glands on either side of the median line. One larger supraintestinal consisting of three parts extending laterally, and one smaller subintestinal. These latter ones also open into the pharynx, but into its ventral side, the pharynx thus being partially developed even on the ventral side. The discharge tubes and chambers are very large, and the latter occupy more than one-half the width of the pharyngeal wall. They stand very close together, and are all of about the same height and form (fig. 112). The dorsal wall of the pharynx is much thicker and denser than the ventral one, and the discharge chambers stand closer and are of more uniform size, more tubular. The discharge chambers on the ventral side are thicker, more pear-shaped and much fewer in number. Fig. 112 represents the lining of the dorsal wall of the pharynx; fig. 115 the ventral wall of the same, and fig. 114 the wall next posterior to the main dorsal section.

Œsophagus and *intestine.* The description given by Benham of the histology of the intestine of *Sp. tamesis* may in the main points be applied to this species. The œsophagus is cylindrical with parallel sides and slightly nipped by the septa. It is sparsely covered by chloragogen cells, which latter are more numerous on the intestine. The ciliæ of the inner epithelium are much longer in the œsophagus, and so are the epithelial cells themselves. Seen in longitudinal section (fig. 110) we find that the transverse muscles surrounding the œsophagus are more numerous and present in several rows, while in the intestine they are few and far between, and arranged only in one row. There is thus a distant approach to a gizzard in the œsophagus. The longitudinal muscular layer is reduced everywhere in the intestine to a single strand, but in the œsophogus it is double, sending out strands to the septa and to the mesenteric sac.

Blood sinus. Both Benham and Smith have shown the existence of a continuous blood sinus in the intestine of the species described by them. In the œsophagus of our present species we find only a vascular network and confluent smaller lacunes, but in the intestine proper we meet with a continuous blood sinus all around the epithelial cells. The radiated appearance of the blood in the sinus, as well as in the other vessels, must as Benham suggested be due to the crystalization of hæmatine. In *Sp. Benhami* and *Sp. Smithi* these crystals are so many and so heavy that they invariably destroyed the edge of the microtome knife and made sectioning most difficult. But the crystalization presents some peculiarities, and in places appears as if there was a mass of radiating fibers always from the side nearest the center of the body radiating towards the periphery, but never the contrary. In *Sp. Benhami* these crystals are much more slender than in *Sp. Smithi.* In the latter species their nature is not to be doubted. They are also found in the hearts, but more rarely in the main longitudinal vessels.

In the intestine we find between the inner ends of the epithelial cells a layer of connective tissue, strengthening as it were that side of the perienteric sinus (fig. 111). Both œsophagus and intestine are enclosed by a thin mesenteric sac, which is nipped by the septa (fig. 111, *mes.*) and pressed close to the chloragogen cells.

Spermathecæ. These are much broader than those of *Sp. Smithi* or *Sp. tamesis*, but resemble more those of *Sp. Eiseni* and *Sp. guatemalensis.* Their position in somites vii, viii, ix, is in the anterior part of the somite, opening in the intersegmental groove and pointing backwards. Their pores are in line with the dorsal couple of setæ, or 3 and 4. The muscular part is tubular, smaller, and consists of two layers, one inner of epithelial cells, one outer thicker, of circular muscles. The inner epithelial layer, which is a direct continuation of the epidermis of the body-wall, consists of very tall, narrow, columnar cells, while the thick muscular coating is a direct continuation of the circular muscular layer of the body-wall. The free end of the spermatheca is wavy and warty in outline, and consists of much shorter epithelial cells, simply covered by the peritoneum. The spermatheca is very broad and very flat (fig. 118).

Sperm-sacs. There are two pairs of lobulate sperm-sacs in xi and xii projecting from the anterior septum. They are situated principally dorsally, and resemble those of *Sp. tamesis*, but are much less lobulate than those, and very much less lobulate than the sperm-sacs of *Sp. Eiseni*, judging from sections of the species sent me by Prof. Frank Smith for comparison.

Large masses of free spermatogonia and spermatozoa are seen in front of the ciliated rosettes.

Ciliated rosettes (fig. 109) are large and very regularly folded. Each rosette sends out a long tubular lip into the sperm-sacs, in way which I have figured in fig. 119c. In a cross-sectioned specimen I found this lip far back in the posterior part of xii. The lower convolute lip of the funnel is almost absolutely regular, and similar in each of the four rosettes. The spermducts appear to resemble those of *Sp. tamesis* and *Sp. Eiseni.* The spermiducal pore is situated just outside of the tubercula pubertatis in the anterior part of xx, just as in *Sp. Eiseni.*

Prostates. Smith is the first to describe the prostates in Sparganophilus. In *Sp. tamesis* they appear not to be present, as Benham does not mention them. In *Sp. Benhami* there are four pairs opening in somites xxiii, xxiv, xxv and xxvi, in front of setæ 1 and 2. The prostates are constructed on the same principle as the prostates in Acanthodrilidæ and Cryptodrilidæ, and consist of two parts; one basal and muscular, one apical and glandular. The glandular part is tubular, straight or folded, of considerable length, but confined to one somite. The glandular part contains an inner epithelium, and surrounding it club-like glandular cells of varying lengths, giving to the surface of the prostate a wavy and irregular appearance. The prostates in this species differ from those of *Sp. Smithi* by having a muscular duct or basal part. This latter does not exist in *Sp. Smithi*, the glandular part in the latter species being immediately attached to the body-wall.

Nephridia. There is undoubtedly some difference in the location of the most anterior nephridia in the various species. In *Sp. Benhami* the most anterior pair is in xii, but they are smaller than those in xiii. In xv we find the first very large nephridium covered with a thick cœlomic cell mantle. This mantle covers the ducts; sometimes we also find a mass of similar cells attached to the nephridium as a rounded, nearly separate mass, only connected with the nephridium by means of a very narrow part. Owing to the great opaqueness of the nephridia, I have not been able to make out the run of all the canals, and can illustrate only a little more than the outline of the organ. It appears, however, that some of the canals are doubled. The outlet duct is very heavy, wide, and its walls are thick. It runs far up into the windings. There is a bridge, and I can distinguish all the various principal parts described by me in the nephridium of Pontodrilus. There are comparatively few blood vessels on the nephridia, and in this respect the species differs from *Sp. Eiseni* and *Sp. Smithi*, in which the nephridia are thickly covered and penetrated by capillaries, causing them to be of a deep pink color. As regards size, the nephridia are as high as the diameter of the cœlom. The nephropores are in front of setæ 1 and 2, and very wide.

Vascular system. Benham's description of the vascular system of Sparganophilus is so complete that I can add but little; the various species seem to agree to a very great degree. *Sp. Benhami* is distinguished by a scarcity of capillaries on the various organs of the body, such as clitellum, nephridia, etc., while in *Sp. Smithi* and *Sp. Eiseni* capillaries are so abundant that they, for instance, almost obscure the nephridial surface. The crystalization of the blood has already been described. It is found in all the vessels of the body, but especially in the mesenteric blood sinus. I have found swimming free in the blood two distinct cell elements, some of which are very large—possibly leucocytes, while others are extremely minute, more round and dense—possibly erythrocytes. But as their description requires more time and study, I will defer it to a separate paper.

The walls of the blood vessels present a banded appearance, caused by parallel bands of thicker tissue, furnished with large circular nuclei, arranged in rather regular rows.

A characteristic feature of the capillaries of this species are the numerous blood glands, similar to those I have described in Pontodrilus and Argilophilus. They are especially numerous in the nephridia and in the septal glands. They also contain a large number of nuclei.

Sparganophilus guatemalensis n. subsp.

Habitat. Guatemala. While in this Central American State several years ago I found a great number of specimens pertaining, as I believe, to at least three distinct species of Sparganophilus. These, as well as my other oligochætological collections made there, were mostly destroyed by accident, few specimens being saved. These are now not in good condition for description, and this must account for the imperfect data I am able to furnish for all species now described from Guatemala. I found Sparganophili in that country in the most varied localities—City of Guatemala at Los Baños, Los Arcos, Laguna Amatitlan, Coban, Panzos Ysabal, Dueñas, etc. The present form is from Los Baños and from Coban.

GENERAL REMARKS.

I consider this a subspecies of *Sparganophilus Benhami*, at least until a closer investigation of better material may reveal other characters, if any there are. *Sparganophilus guatemalensis* is one of the smaller species about 10 cm. long by 2 mm. wide; the specimens were considerably stretched. Color is deep flesh, with an intense deep, dark violet lustre, much darker than in any other species and well preserved in alcohol, in which the specimens appear blackish violet.

Setæ are lateral and dorsal.

Clitellum extends from xvi–xxvi, but cannot be well defined on the ventral side. The *tubercula pubertatis* are in the shape of two parallel ridges extending from xviii to xxii or specimens from Patal and Coban, which I take to belong to the same species as those from Los Baños in the City of Guatemala.

INTERNAL CHARACTERS.

Of these I could only distinguish a few. The *spermathecæ* are in three pairs, one each in vii, viii, ix, opening in the anterior intersegmental groove. The apical end in the fully developed spermatheca is very wide, flattened like a mason's trowel. Several of the spermathecæ possessed a slit or opening in the apical end which communicated with a longer or shorter sac, continuous with the exterior lining of the rest of the spermatheca. It is possible that this is only a result of maceration, as I have seen nothing like it in other species of Sparganophilus, and it is not probable that we here have an analogy with the spermathecæ of Enchytræus or Sutroa, where this organ communicates with the intestine.

Prostates are found in four pairs and situated in somites xxiv–xxvii or one somite further back than in *Sp. Benhami*. This in specimens from Sapote. If this character holds good it is one of considerable importance.

Hearts were in viii, ix, x, xi strongly developed, but not filling the cœlom. Some of the Guatemala Sparganophili possessed only three pair of hearts in somites ix, x, xi, with the ventral vessel branching in xv/xvi. Those were specimens from Los Arcos. Others again from Amatitlan possessed the hearts in x, xi, xii, xiii, with the ventral vessel divided in xv/xvi, while those from Los Baños, Guatemala City, had the ventral vessel branched in xiv/xv. I believe those from Amatitlan and Los Arcos belong to different species, but, as all the specimens are lost, I can only call attention to the differences and to the importance of further investigations.

Sparganophilus carneus n. subsp.

Habitat. Mississippi river near Clayton, Iowa, in soil at the water's edge, under pieces of boards and lumber. Numerous specimens at end of August, 1890, only few of which were adult.

General remarks. It is probable that this is only a northern form of *Sparganophilus Benhami*, from which species it differs principally in the form of the spermathecæ, and by a much lighter color. The specimens at my command were not in proper condition and the shape and position of the tubercula pubertatis could not be made out.

My object is merely to call attention to this form which after all may be more distinct as more of its structure is known. In regards to the form of the spermathecæ it differs much more from *Sp. Benhami* than does the other subspecies *Sp. guatemalensis*. It is also much smaller.

CHARACTERISTICS.

Color is much lighter, more flesh and less violet than that of *Sp. Benhami* and *Sp. guatemalensis*, and the irridescence more faint. The species is smaller than *Sp. Benhami*, being about 9 cm., about one-half the size of that species.

Clitellum in the most developed specimen occupied xv–xxiv ventrally, dorsally it could not be properly defined. Prostates present with certainty in xxiii, xxiv, but owing to the somites being torn in xxv, xxvi I could not with certainty ascertain their presence there.

Setæ are similar to those in *Sp. Benhami*. The anterior xxii somites have much larger setæ than the other, except the most posterior ten. The setæ increase in size from somite ii to somite xv, then diminish backwards to xxiii, in which somite they are smaller yet, this size continuing to the tail, where at about ten somites from the anus the setæ again begin to increase. There is no parietal gland in somite iii as in *Sp. Eiseni*, and this is the chief reason why I class this species under *Sp. Benhami*. The *spermathecæ* are in three pairs and open in front of 3 and 4 dorsally. Their shape resembles much more those of *Sp. Eiseni* than they do those of *Sp. Benhami*. The apical end is globular and very much larger than the basal part. The spermathecæ are not trowel-like. I give some outline drawings of the spermathecæ taken from one and the same individual.

Sperm-sacs are very large in xi, xii, the one in xxii projecting into xxiii filling the somite also. The sperm-sacs are coarsely lobulate, much less so than in *Sp. Eiseni*.

The *capillaries* resulting from the lateral integumental vessels are very large in the anterior six somites. The hearts also are very large and seem to fill all available space on the cœlomic cavity in viii, ix, x, xi.

Deltania Troyeri Eisen, n. var. **crassa.**

Figs. 142, 143.

DEFINITION. *Size 45 mm. by 2 1-2 mm. Septal glands in v and vi, about twice as thick as the septum. Spermathecæ each with two diverticles, which have the apical ends globular and inflated. Prostates thick, with the glandular part about 1 1-2 times longer than the thin muscular duct. Habitat, Baja California.*

In other respects like the type, judging from two dissected specimens.

Habitat. Of this variety I possess only three specimens, from Ensenada de Todos Santos, in the northern part of Baja California, on the Pacific Coast side. They were taken in the same locality as *Aleodrilus Keyesi*, in the pure sand in the creek bottom, in a spot which had been kept moist by the accumulation of some sacks and rubbish. The specimens became strongly contracted, on account of the necessity of immediately placing them in alcohol.

EXTERNAL CHARACTERS.

The variety resembles the main form in most respects, but is much larger, especially thicker. The contracted specimens were as long as the longest of the main form from San Francisco, when fully extended, and twice as thick, and must, when alive, have measured 45 mm. by 2½ mm. Other external characters agreed exactly with those of *Deltania Troyeri* type from San Francisco, California. The deltoid arrangement of the ventral setæ in the genital region was identical, which satisfies me that we in this arrangement have most important species characters between the species of this genus.

INTERNAL CHARACTERS.

The variety differs from the type in two particular points.

The *septal glands* are present only in two somites, v and vi, and are exceedingly thin, or about one-fourth as thick as those of *D. Troyeri* type. This refers to those superior to the intestine. Those below the intestine I could not discern, as no sections were made. The glands were lamellæ-like, and only about twice as thick as the septum.

The *spermathecæ* were thicker than those of the type, with more inflated diverticula.

The *prostate* was thick, and its glandular part about 1½ times longer than the very thin muscular duct. Two or three fully developed penial setæ with each prostate.

Deltania Troyeri Eisen, n. var. **lagunæ**.

Figs. 144–147.

DEFINITION. *Size 32 mm. by 1 1-2 mm. No copulatory papillæ. Setæ a and b next posterior to clitellum, reach their final distance in the fifth somite posterior to clitellum. Spermathecæ in ix twice as large as those of the type, contracted at center, apical part swollen. Prostates more slender than in the type. Large ovisacs. Habitat, Baja California, Sierra Laguna.*

DETAILED DESCRIPTION.

Habitat. The exact locality in the Cape Region of Baja California and Sierra Laguna is a camping-place called La Joya. There, where the trail crosses the creek the water had backed up behind some fallen logs causing a miniature mudflat covered with leaves and sediment. The specimens were found in the rotten wood and under the decayed leaves in the mud. Altitude about 5500 feet.

EXTERIOR CHARACTERS.

The average specimen is larger than the type from San Francisco, the largest specimen of the latter being smaller than the average mature specimens of the variety *lagunæ*. The two round copulatory palpillæ figured by me from *D. Troyeri* are not seen in the variety. The sacs of penial setæ in several dissected specimens possessed each two penial setæ fully developed, one having three, but of which one was undeveloped. One of the setæ is a trifle more curved than the other. The point of each penial seta shows a slight and indistinct ornamentation (fig. 144). Since my first description of *D. Troyeri* I have found some more mature specimens at the old locality in San Francisco. One of these specimens possessed two penial setæ in each sac, both slightly sigmoid, with trace of ornamentation at the free apex. In the variety *lagunæ* the ornamentation is more distinct.

Common setæ resemble the type, but setæ *a* and *b* next posterior to clitellum reach their proper and final distance from each other only in the fifth somite posterior to clitellum, while in *D. Troyeri* type they reach the final distance in the third somite posterior to clitellum.

INTERNAL CHARACTERS.

Spermathecæ are much larger in the variety *lagunæ*, or about twice the size of those in *D. Troyeri*, with the main body distinctly contracted at the center, and with the apical part much enlarged. The diverticula are distinctly tri-digitate and reach up to the narrow contraction of the main sac.

Prostates or spermiducal glands are much more slender and longer than in *D. Troyeri* type, and generally but not always confined to one somite.

Ovisacs are two, projecting from the septum xiii/xiv into xiv, occupying the largest part of the cœlomic cavity in the latter somite. The structure of the ovisac is characterized by numerous trabecula forming an extensive system of round pockets of various sizes. Where there are no pockets there are solid zones of round or slightly oval nuclei (fig. 147) imbedded in a dense mass of tissue without distinct cell-walls.

PHŒNICODRILUS Eisen.

The finding of a new species of this genus enables me to more properly define it. The genus was originally based on the absence of a prostate at the male-pore, there being, however, a short muscular atrium, in which opened the spermduct. The type was *Phænicodrilus taste*, a species from the Cape Region of Baja California. The new species described below under the name of *Phænicodrilus tepicensis* possesses a much more developed atrium, in shape and structure resembling a spermatheca. There is a total absence of glandular cells, such as are found in prostates, the whole atrium being muscular. There is besides another difference between Phœnicodrilus and Ocnerodrilus, though of much smaller importance. In Phœnicodrilus we find a large number of muscular fascicles divided in three paired groups in somite xvii, radiating from the male pore. In Ocnerodrilus these arciform muscles are few in number. In Phœnicodrilus these muscles are so thick and numerous that the atrium itself can only be seen in sections, not by suface view of the inner side of the body-wall.

Through the possession of a muscular atrium this genus comes rather close to Nannodrilus Beddard. This genus, of which so far only one species is known from Africa, possesses a muscular bursa copulatrix, in which opens separately the anterior prostate and the anterior spermduct. The great similarity between the atrium in Phœnicodrilus and the bursa copulatrix of Nannodrilus is very striking, especially as the spermducts in Phœnicodrilus also open into the atrium. But the question that still remains to be settled is this. Is the atrium in Phœnicodrilus a modified bursa copulatrix, or is it simply the remains of deteriorated prostate. The absence of a penis in Phœnicodrilus makes the latter alternative seem most probable. While in Ocnerodrilus the reduction of the prostate consists in the loss of one layer of glandular cells in the apical part, this reduction has proceeded further in Phœnicodrilus, the whole glandular apical part here being wanting.

The principal differences between the genera Ocnerodrilus and Phœnicodrilus are then as follows:

Ocnerodrilus. A prostate of varying size is always present at the male pore. This prostate consists of two parts, one glandular, lined by a single layer of cells, and one muscular basal part.

Phœnicodrilus. No prostate, only a short or rudimentary muscular atrium, in the lower part of which opens the spermduct.

Phœnicodrilus taste Eisen.

DEFINITION. *Atrium rudimentary, muscular and bulbous, only about twice as thick as the spermducts. No ovisac. Spermathecæ covered with warty excrescences. Arciform muscles in xvii comparatively few.*

This species, which I first described from the west coast of the Cape Region of Baja California, has since been found by Messrs. Eisen and Vaslit in two widely separated localities. It was found in great numbers at Miraflores, on the east side of the Sierra of the Cape Region, some 30 miles north of San José del Cabo, together with *Ocnerodrilus Beddardi,* Sept., 1894. It was, however, quite unexpected to find this species also common in garden soil at San Blas, the seaport in the territory of Tepic, several hundred miles south of the Cape Region peninsula. I can find no differences in the anatomy, nor in the exterior of the specimens from these respective localities. The small copulatory papilla in somite xiv, lateral to the oviduct, is present in all. So are the numerous muscles in the copulatory region around the male pore.

Phœnicodrilus tepicensis n. sp.

Figs. 155–160.

DEFINITION. *Atrium about twice as long as the body wall, but hidden by arciform muscles in somite xvii. A median ovisac in xiv/xiii. Spermathecæ entirely smooth, without warty excrescences. Arciform muscles in xvii very numerous.*

Habitat. Numerous specimens in and around the city of Tepic, territory of Tepic, Mexico, 4000. In moist soil under logs, in gardens, etc. November, 1894. Found together with *Acanthodrilus Vasliti.* Only few specimens were adult in November.

EXTERIOR CHARACTERS.

Size 4 cm. by 1½ mm. Number of somites 75.

Clitellum incomplete, comprising somites xiii–xix.

Setæ strictly paired, sigmoid plain. The pair 1 and 2 is wanting in xvi.

Spermathecal pores in ix in front of setæ 1 and 2.

Oviducal pores in xiv in front of setæ 1 and 2.

Spermaducal pores in the center of xvii, where otherwise would be the setæ 1 and 2. A small copulatory papilla around each male pore, but it is not connected with a zone. No dorsal pores.

INTERNAL CHARACTERS.

Muscles. Numerous arciform muscles in the copulatory region, but especially in xvii, connecting the copulatory papillæ with the body-wall in line with setæ 3 and 4. These arciform muscles are arranged in three distinct groups. The central group, which branches out fan-shaped from the inner surface of the copulatory papillæ, is by far the largest, consisting of about 10 to 12 distinct fascicles. Anterior to this is another group of 6 to 7 fascicles, and in the posterior part of the somite we find a swollen group of about 5 fascicles. To what extent these vary as to numbers, etc., is uncertain, but my observations in *Phœnicodrilus taste* are that they are quite constant, and might be used as valuable characters in determining the species, as with a change in the muscular strands is also connected one in the exterior copulatory zone. Between xvii and xiii, as well as between xvii and xix we find several pair of arciform muscles in each somite.

Septal glands are well developed. The suprapharyngeal glands are very long and extend far backwards. The septal glands in the following somites diminish posteriorly.

Spermathecæ. One pair in ix open between viii/ix in front of setæ 1 and 2. Form sac-like, very thin walls, pellucid, outline smooth, without any warty diverticula. No distinction between a muscular and glandular part. The size is large, about as long as the somite is wide.

Testes, ovaries and ciliated rosettes not characteristic.

Ovisac. There is a median ovisac in xiii/xiv (fig. 157), consisting of a pouching backwards of part of the septum. This is the only species in the three genera, Ocnerodrilus, Gordiodrilus and Phœnicodrilus, which possesses an ovisac.

Spermducts are of the same width throughout, without any muscular enlargement near the male pore. The two ducts run together, but their lumens are separate until they reach the muscular atrium, where, just before they enter it, the two lumens fuse into one (figs. 158, 159).

Muscular atrium. As has already been stated the usual prostates in Ocnerodrilus are replaced by a pair of muscular pouches, entirely covered up by the numerous arciform muscles. There are no glandular cells, and these atria can best be compared to the basal muscular parts of the Ocnerodrilid prostate only they are very much thicker, and consist entirely of muscular cells with the lumen in the body-wall lined by columar epithelium. In the main pouch this epithelium consists of short cells with round nuclei, around which extends a thin muscular layer, which becomes wider at the base. This atrium is very short and cannot readily be seen when the opened body cavity is viewed from the interior surface. It is attached to the at this point very much thickened body-wall (fig. 158) by numerous muscles and connective tissue. The various species of Ocnerodrilus, especially those with short prostates, require reinvestigation in order to ascertain the structure of the prostates. Should intermediate forms be found it might become proper to merge the two genera into one.

Nephridia. Those anterior to clitellum are not covered with a cœlomic cell mantle, while those posterior to the clitellum are surrounded by a very thick one. The structure of the nephridia appears to be similar to those of *Phœnicodrilus taste,* at least in a general way.

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REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
n. nephridia.
n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. org. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

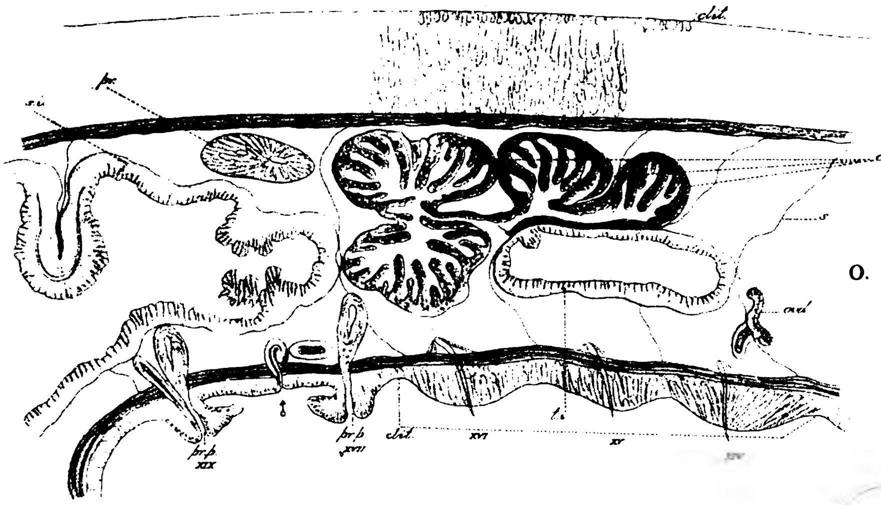
PLATE XLVI.

BENHAMIA PALMICOLA.

0. Longitudinal section of the genital somites.

BENHAMIA NANA.

1. A specimen; natural size.
2. The ventral side of the anterior somites, showing the exterior pores, etc.
3. The ventral side of the most anterior somites, showing the everted pharynx and the very narrow somite i, etc.
4. Side view of the same somites.
5. The anterior twenty somites laid open, exposing the various organs, etc. The alimentary canal is removed and the whole figure is held somewhat schematic. *atr*. thickened part of the spermducts.
6. Part of a posterior somite viewed from the inner side, showing the relative position of setæ and nephropores. 1, 2, 3, 4 refer to the setæ; a, b, c to the nephridia.



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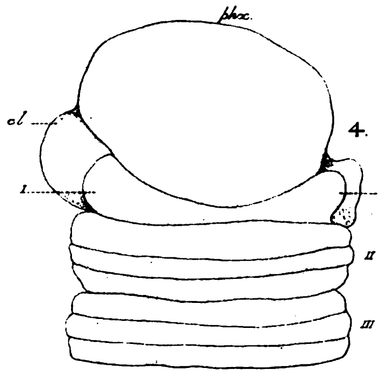

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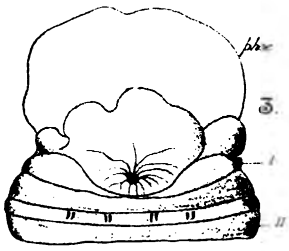

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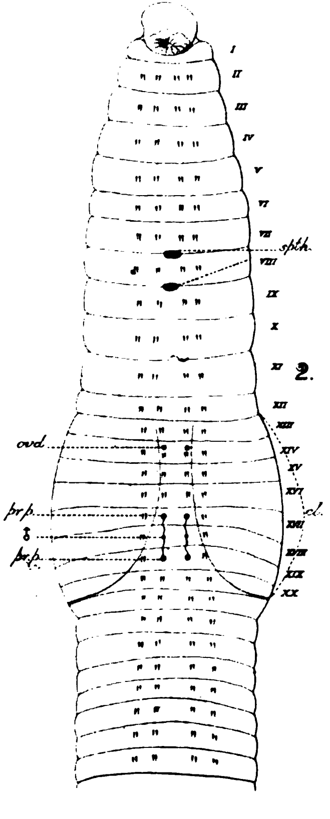

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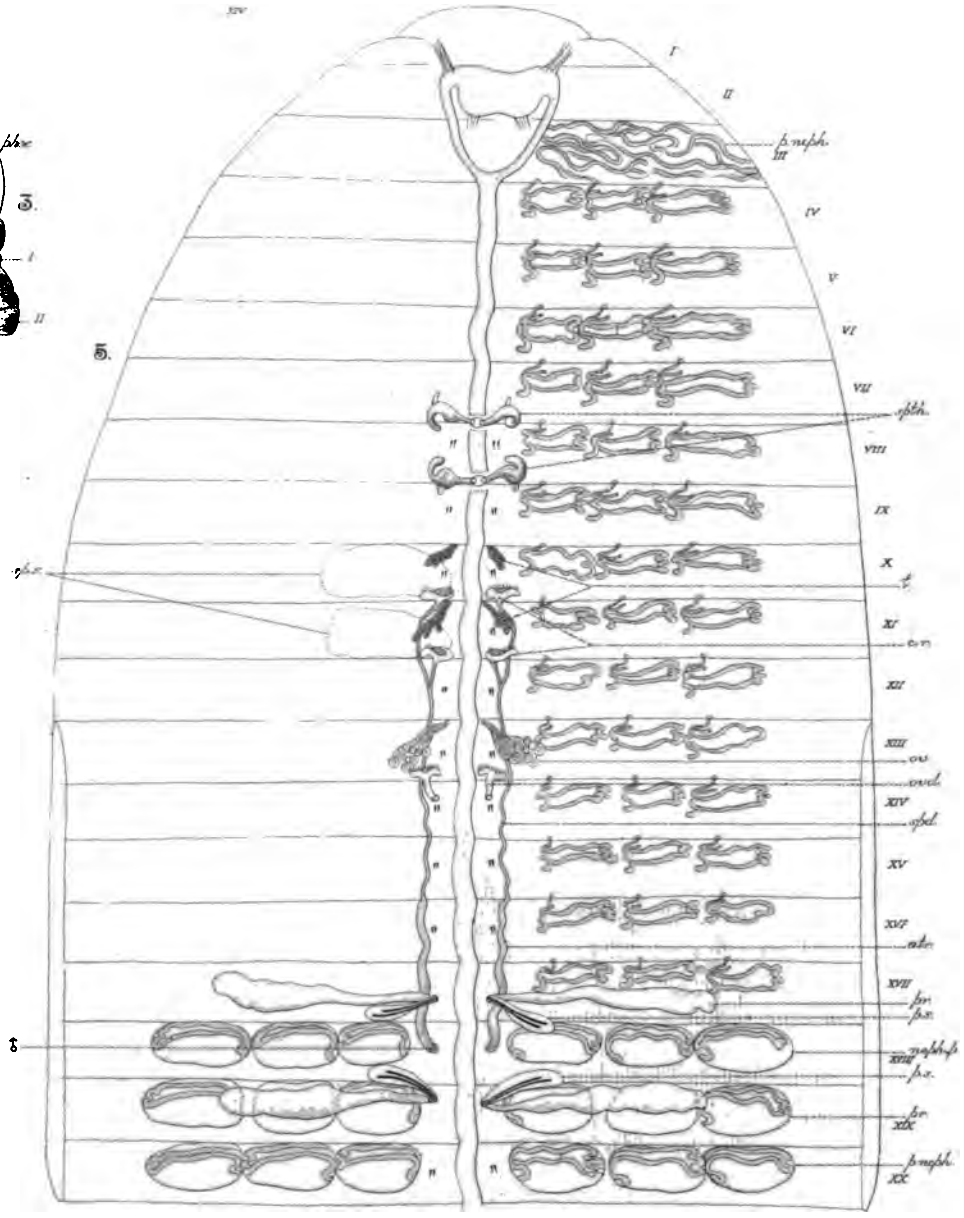
1.



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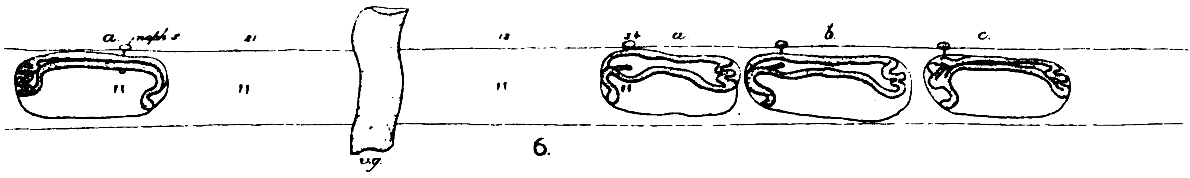

6.

GUSTAV EISEN DEL.

LITH. BRITTON & REY, S.F.

BENHAMIA PAPILLATA FIG 0.   BENHAMIA NANA FIG'S. 1 TO 6.

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
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sep. septum.
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spth. spermatheca.
spth. p. spermathecal pore.
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t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. " windings " of nephridial ducts.

PLATE XLVII.

BENHAMIA NANA.

7. A somewhat diagrammatic figure representing the anterior part of a specimen sectioned lengthwise, composed from several sections, showing the location and size, etc., of various organs. *x.* beginning of the muscular part of the spermduct.
8. Cross-section through the most anterior part of the body, through prostomium and buccal division, showing the pharyngeal glands in four distinct divisions. The section is anterior to the cephalic ganglion.
9. Section posterior to the former, through somite ii.
10. Section through somite vii.
11. Section through somite xiv; the calciferous gland with the intestine belongs to somite xiv; the ovary to xiii. The section passes just in front of the oviduct. *x.* the limit of the clitellum.
12. Section through somite xvi. The calciferous diverticula belong to somite xv.
13. Section through somite xvii and the anterior prostate pore. *x.* ending of clitellar cells.
14. Section through somite xx, showing the typhlosole.
15. Longitudinal section through the most anterior part of the body, showing the projected pharyngeal division with the gland ducts. *phx.* pharyngeal division. The dark line indicates the row of discharge chambers of the ducts from the glands. A more magnified view is represented in fig. 18.
16. A couple of strands of the unicellular salivary septal glands with their muscles.
17. Some of the septal unicellular glands more highly magnified.
18. Section through pharynx, showing the discharge ducts and pockets from the septal and pharyngeal glands.
19. Lining of the œsophagus below the salivary glands, showing its exceeding thinness.
20. Longitudinal section through the body-wall, showing the sense organ region in the equatorial line of the somite. *c. e.* central lumen or organ proper, in which are seen the sense cells, together with nuclei of supporting cells. These supporting cells are surrounded by peculiar lunate or sac-like transparent cells, also found in the sense organ of the pharynx. *n. c.* nerve cells and their nuclei.
21. Longitudinal section through gizzard, showing glands with their discharge tubes and small terminal pockets.
22. Section through the alimentary canal between the two gizzards, showing glands. *c.* cluster of lunate cells surrounding a lumen.
23. Longitudinal section of the tubular intestine from somite xvi. *u. c.* unicellular glands. *bl. s.* blood sinus.

24ı. One of the lobes of the typhlosole, showing distribution of glands, some of which are dark staining, others not.

24b. Section through the intestine adjoining the typhlosole.

25. Two glandular cells from the former section, more magnified. The two glands belong to different types.
26. A pair of calciferous diverticula from xiv. The right-hand gland is much smaller, which is an exception, as generally they are of equal size.
27. Detail of a section of lamella from one of the anterior calciferous diverticula.
28. Two cells more highly magnified.
29. Section through one of the posterior calciferous diverticula.
30. Part of the same more highly magnified. Zeiss Hom. Im. Eyp., 2.
31. One of the prostates with sac with penial setæ.
32. Cross-section through glandular part of prostate.
33. Part of a penial setæ near the apex; the latter is broken.

III
IV
V
VI
VII
VIII
IX
X
XI
cd

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
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s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellar glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE XLVIII.

BENHAMIA NANA.

36. Section through one of the prostate pores, showing prostate, sac with penial setæ and the thickened spermduct. *x.* at this point the clitellar cells cease. *c. t.* connective tissue between the two muscular layers.

37. Cross-section of the thickened part of the spermduct, showing the two lumens separate.

38. Section through the muscular part of the prostate, showing the epithelium and some of the muscles nearest the lumen.

39. One of the posterior nephridia; the shaded sac-like part represents the cœlomic mantle. It is generally covered with capillaries to such an extent that the structure of the organ is obscured. *br.* bridge. *nec.* neck of narrow duct. *spr.* spur. *o.f.* anterior fold. *p.f.* posterior fold.

40. One of the anterior nephridia, showing absence of cœlomic glands, also the arrangements of blood vessels.

41. Part of the nephridium more magnified. No capillaries are represented.

42. Part of cœlomic mantle of one of the posterior nêphridia. *se.* secreted matter staining very deep. *n.* nuclei of the glandular cells.

BENHAMIA PAPILLATA.

43A. A specimen, natural size, from Tepic.

43B. The ventral zone of the clitellum.

43C. The same more highly magnified, showing the papillæ and prostate pores.

43D. The two penial setæ in one sack. Zeiss D. Eyep., 2.

43E. The tips of the two penial setæ. Zeiss 12, Eyep., 2, 1.

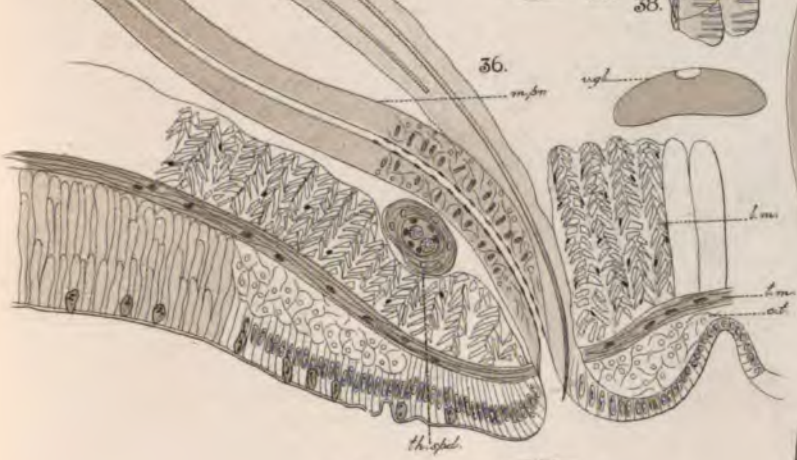
BENHAMIA PALMICOLA.

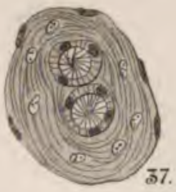
44A. The ventral side of the anterior somites.

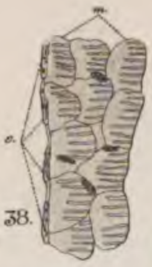
44B. The ventral region of the clitellum.

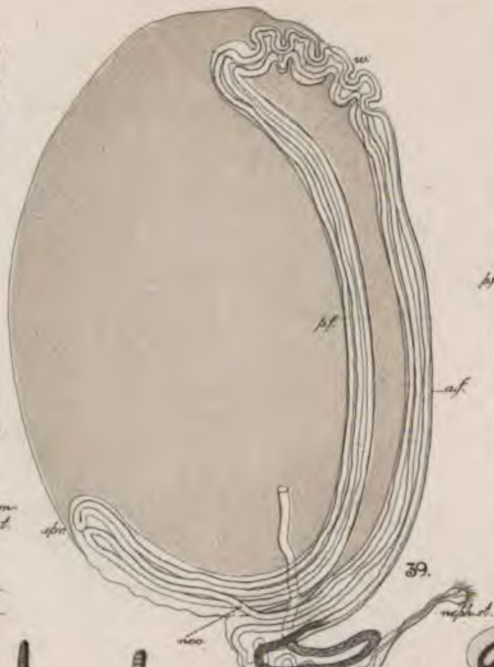
44C. A specimen, natural size.

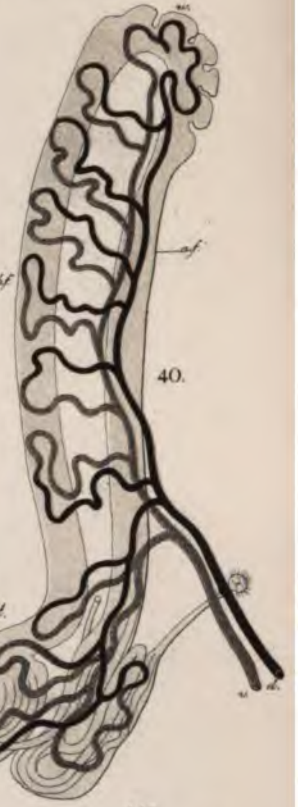
45. Penial setæ. A. apex of the shorter setæ. B. apex of the longer setæ. C. two setæ, whole.

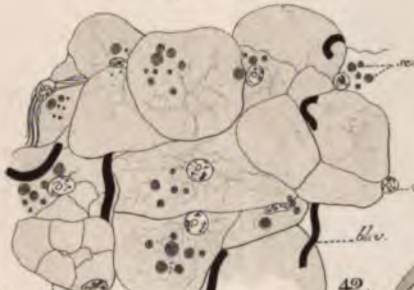


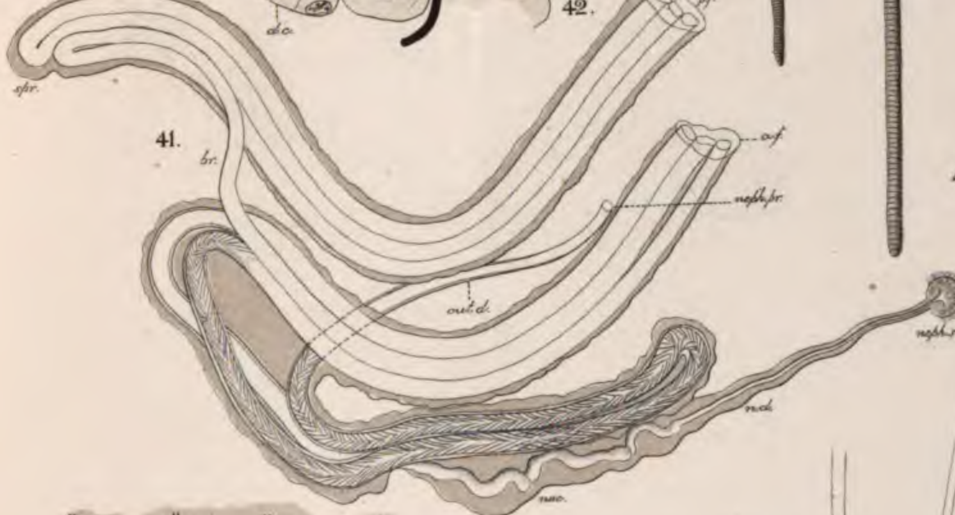


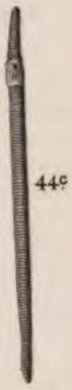


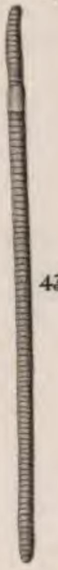


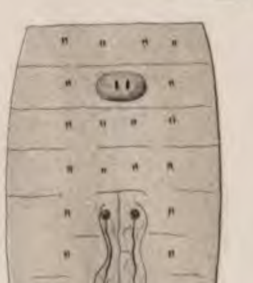


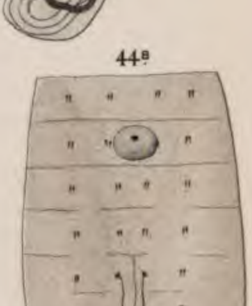


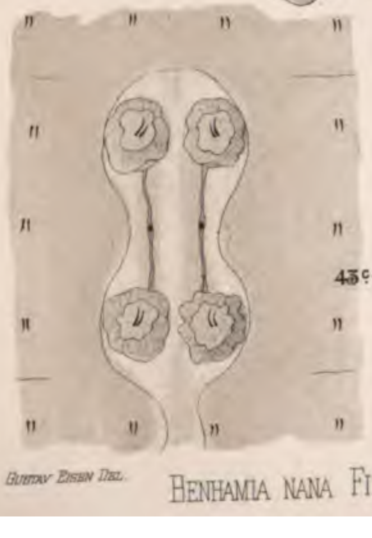


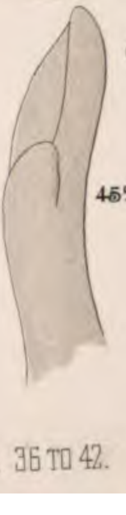


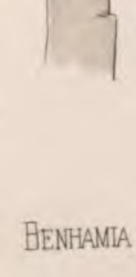


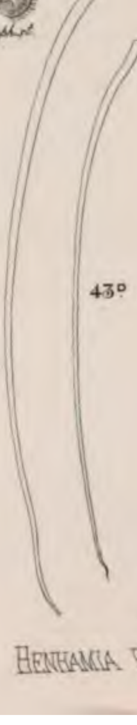


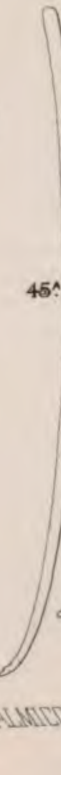


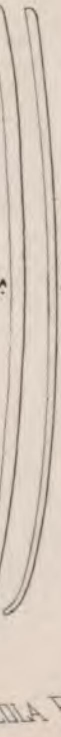


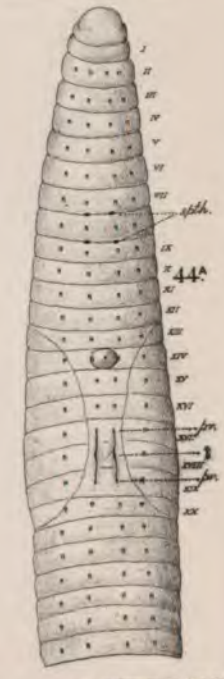












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BENHAMIA NANA FIG'S. 36 TO 42. BENHAMIA PAPILLATA FIG. 43. BENHAMIA PALMICOLA FIG'S. 44 & 45.

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REFERENCE TO LETTERS ON PLATES.

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a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
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v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE XLIX.

BENHAMIA PALMICOLA.

46. A somewhat diagrammatic figure, composed from several longitudinal sections. *s. org. pr.* sense organ zone of the prostomium. *s. org. b.* the sense organ zone of the body wall, on the equatorial line of the somite.

47. Some of the sense organ cells of the prostomium more highly magnified. Zeiss. 12; Hom. Im. Eyrp. 2. The sense cells are seen in the center between the pellucid sac-like cells. Between the sense cells are seen nuclei of supporting cells.

48. Part of a posterior somite laid open, showing the three nephridia on one side.

49. A part of a nephridial cell mantle, showing various kinds of cells, some of which appear to contain calculi.

50. Cephalic ganglion, etc.

51. The spermathecal zone seen from the inner side of the body. The large globular apical part of each spermatheca is situated in the somite posterior to the pore.

52. Outlines of the spermathecæ of various extra African species of Benhamia, some of which are copied from various sources.

52A-B-C-D. Spermathecæ of *Benhamia Bolavi*, from specimens from Hamburg, kindly furnished by Dr. W. Michaelsen.

52E. Spermatheca of *Benhamia malayana* after Dr. Horst.

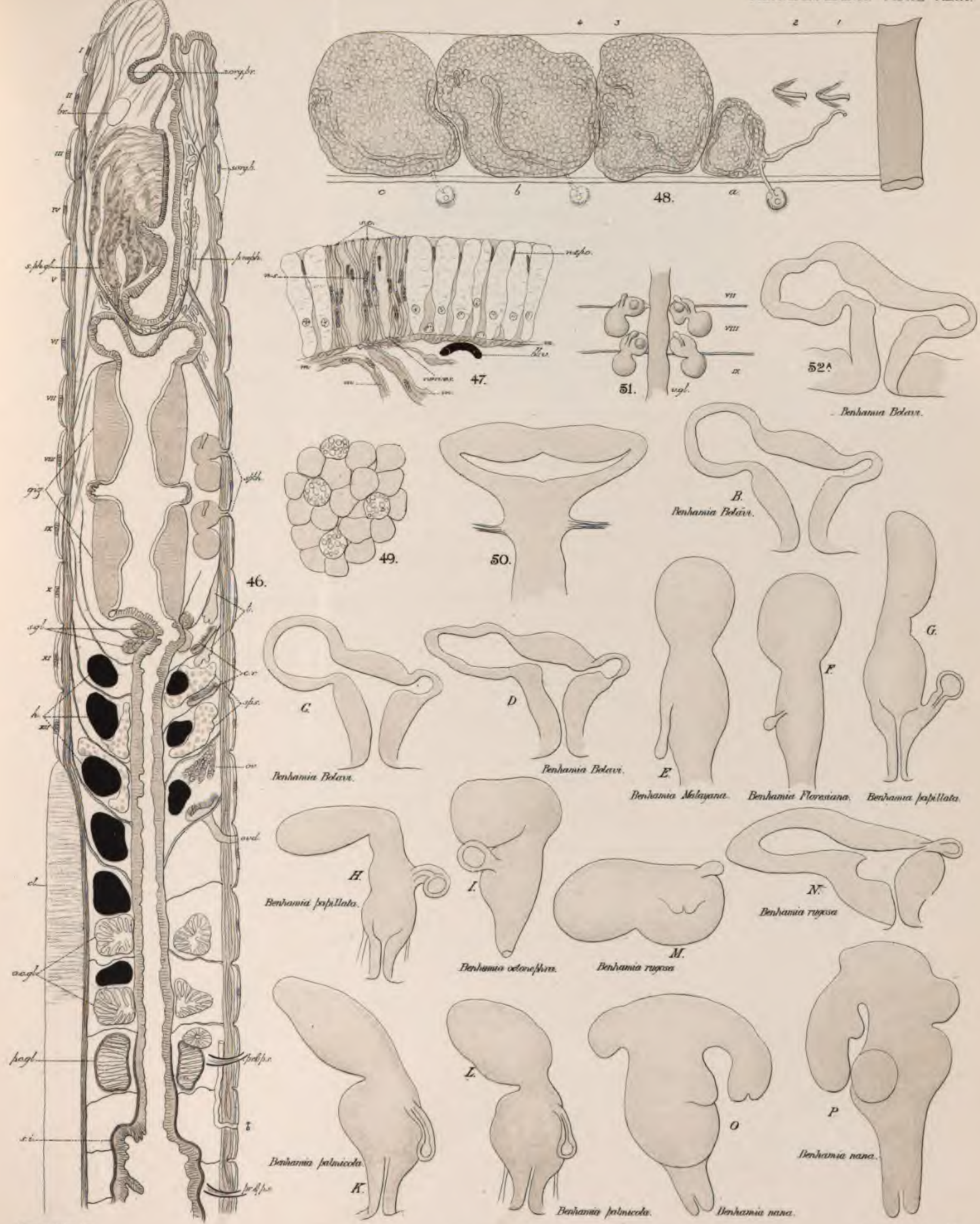
52F. Spermatheca of *Benhamia floresiana* after Dr. Horst.

52G-H. Two spermathecæ from the same side of a specimen of *Benhamia papillata* from Tepic, Mexico.

52I. Spermatheca of *Benhamia octonephra* after Rosa.

52K-L. Spermathecæ of *Benhamia palmicola* from Miraflores, Baja California.

52M-N. A spermatheca of *Benhamia rugosa* seen from two different sides.



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BENHAMIA PALMICOLA FIG'S 46 TO 51

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REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
n. nephridia.
n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. org. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE L.

BENHAMIA PALMICOLA.

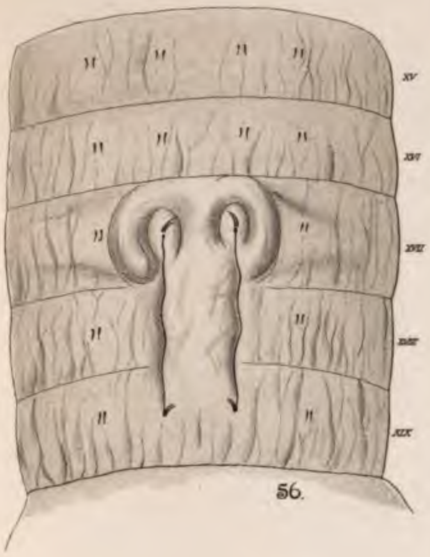
53. Part of the intestine and hearts dissected out.
54. Prostate and sac with penial setæ.

BENHAMIA RUGOSA.

56. The ventral side of clitellum, showing the copulatory papillæ on which are situated the anterior prostate pores in xvii. The clitellum is much crenulated.
57. Anterior somites seen from above, showing prostomium, somite i, ii and iii, the first of which is much swollen.
58. The same seen from the side. In these two figures somite i is retracted in the buccal cavity.
59. Another specimen; the anterior somites, but i, is fully extended.
60. Larger penial setæ, free end.
61. Smaller penial setæ.
63. A partly diagrammatic representation of the interior surface of a posterior somite, showing the nephridia. 1, 2, 3, 4, small, refer to setæ; 1, 2, 3, 4, large, refer to nephridia.

ALEODRILUS KEYESI.

66. A specimen, natural size.
67. The anterior somites seen from the ventral side, showing the generative pores and the position of setæ.
68. Prostomium and somite i.
69. The sexual fossæ and papillæ.
70. A somewhat diagrammatic view of the anterior somites, composed from several longitudinal sections.



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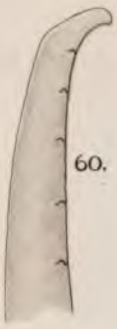

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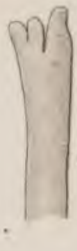

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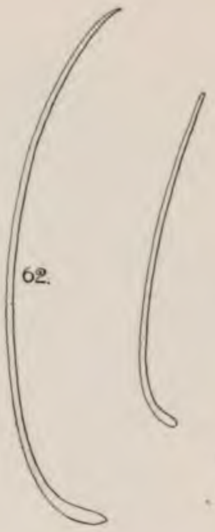

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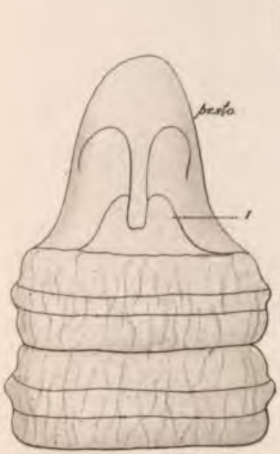

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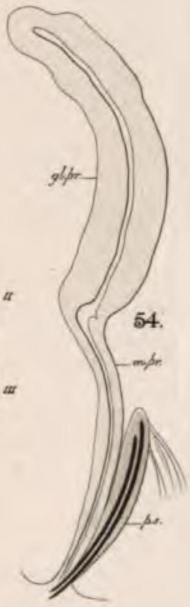

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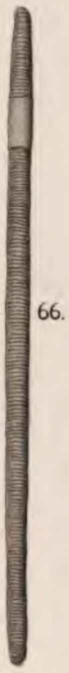

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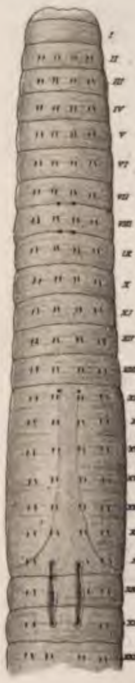

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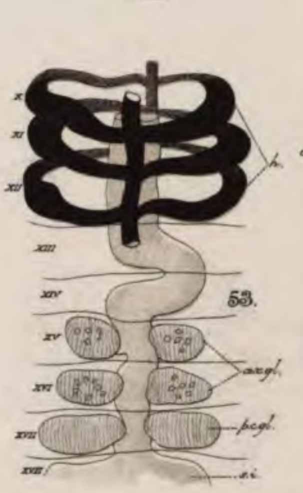

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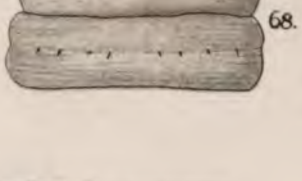

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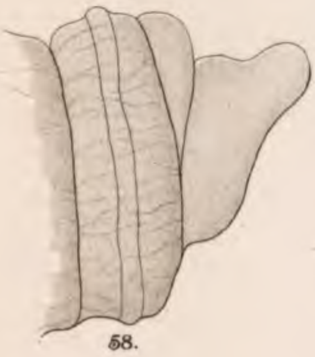

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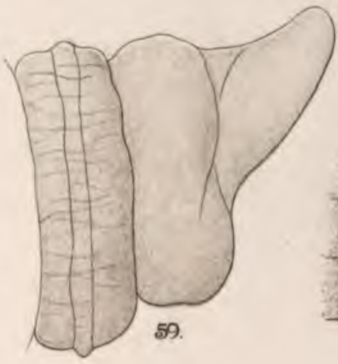

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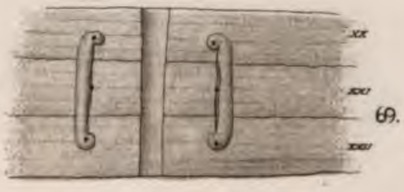

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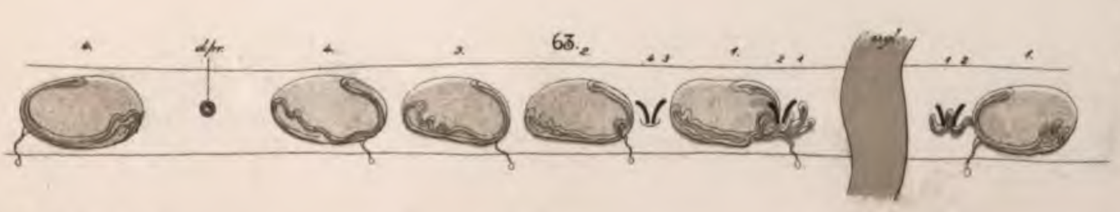

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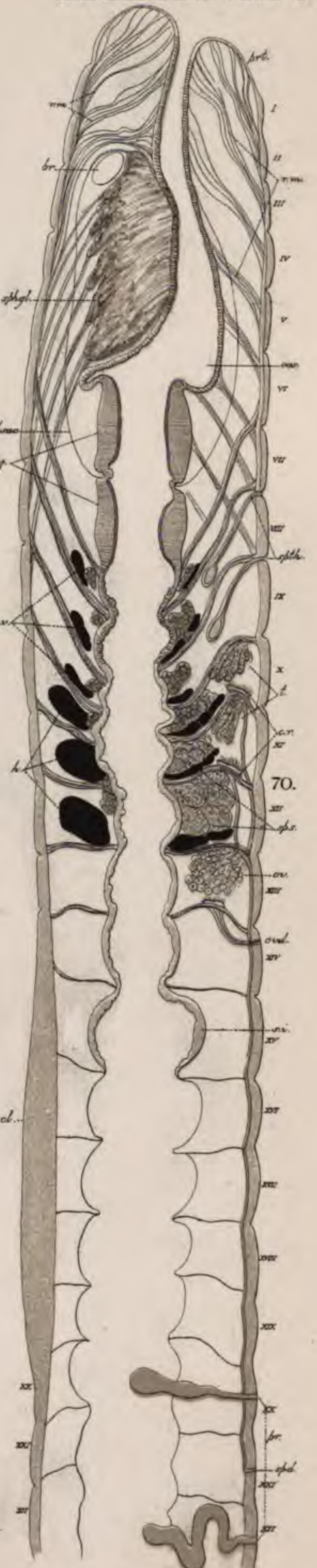

70.

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BENHAMIA PALMICOLA FIG'S. 53 & 54. BENHAMIA RUGOSA FIG'S. 56 TO 63. ALEODRILUS KEYESI FIG'S. 66 TO 70.

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
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cil. ciliated epithelium.
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tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. " windings " of nephridial ducts.

PLATE LI.

ALEODRILUS KEYESI.

71. Cross-section through somite ix, showing the septal glands and the thickened septa. *s. gl.* septal gland, the prolongation of which probably connects with the intestine and the median blood vessel. *x.* at this point the ventral vessel and the septal gland have been bent and cut twice.

73. Cross-section through somite xii, showing the posterior sperm-sac. *tra.* trabecula. *v. v.* ventral vessel in two successive somites. *spc.* sperm-cell germinative area of cells with narrow nuclei.

74. Section through apical part of spermatheca.

75. Section through intestine and septal gland in somite x, anterior to fig. 72, showing discharge duct of septal gland. The ventral vessel and heart have been folded and cut three different times; similarly part of the septal gland has been cut twice. *d.* discharge duct of septal gland; it probably reaches in between the epithelial cells of the intestine.

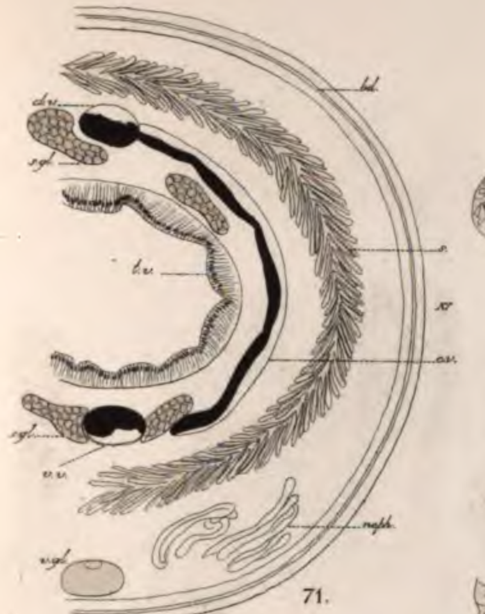
77. Section through dorsal median vessel, where it connects with two lateral vessels; the section goes only through one of the points of connection. The lateral vessels are covered with chloragogen cell.

78. Section through the suspended posterior part of the spermduct in the anterior part of somite xii. The duct is seen suspended between two mesenteric strands, one connecting with the heart, the other with the septum close to the body wall. *h. v.* heart valve. *gl.* gland emptying in spermduct.

79. Section through spermduct in somite xi, the cut going through testis, which is immediately superposed on the duct or rather the posterior part of the ciliated rosette.

80. Section through spermduct going through the ovary in xiii. *a. spd.* spermduct from anterior rosette, already attached to the body wall. *p. spd.* spermduct from posterior rosette, yet suspended and passing through the ovary. *ov.* ovary with full-grown ova, with germ-cells and with a germinative area where cells are in mitosis. The nuclei in the germ-cells are oval, while those in the grown ova are round. Zeiss D. Eyp. 2.

81. Section through spermduct through one of the posterior somites where the two ducts have joined in the body-wall. *clit.* clitellum in xiv.



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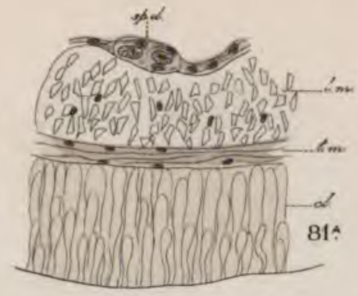

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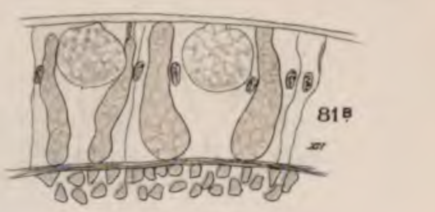

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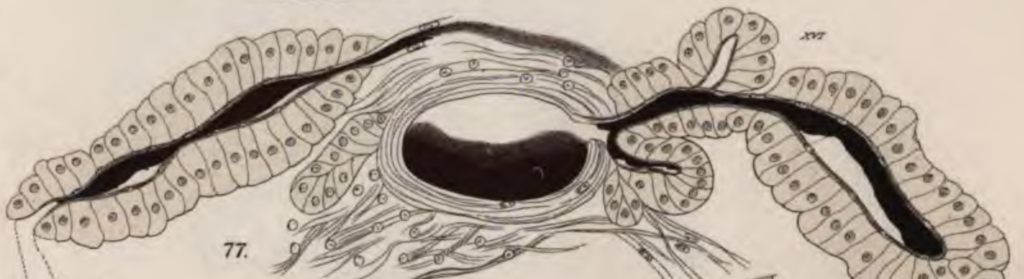

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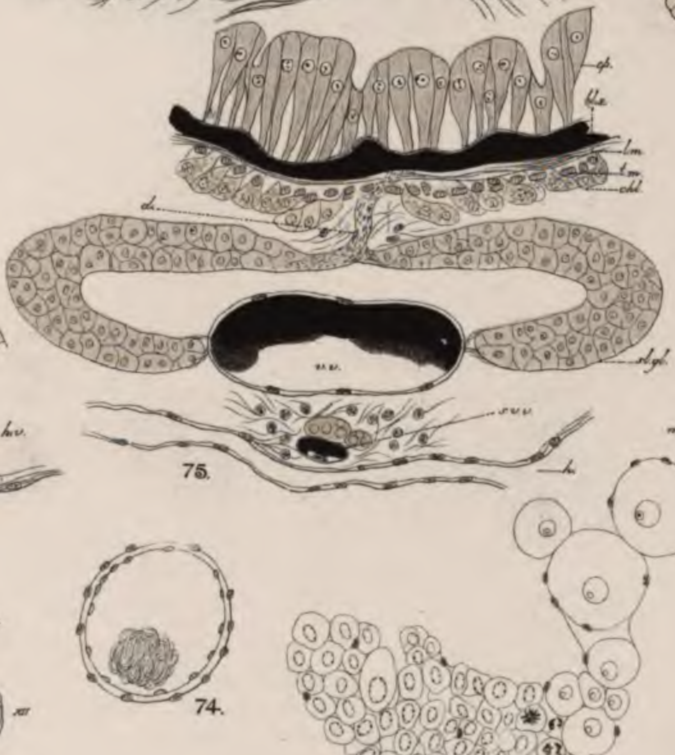

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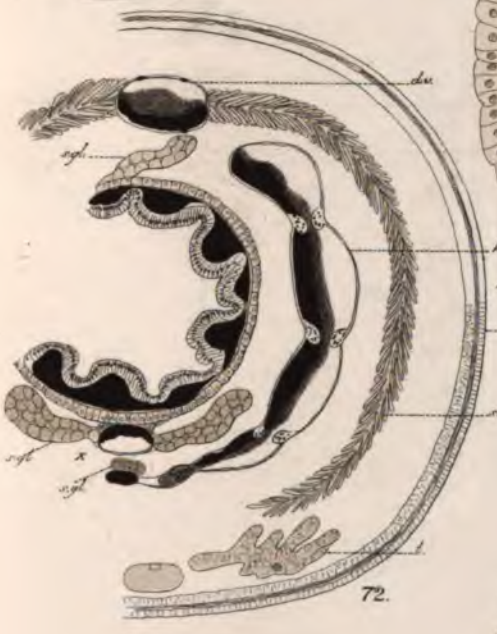

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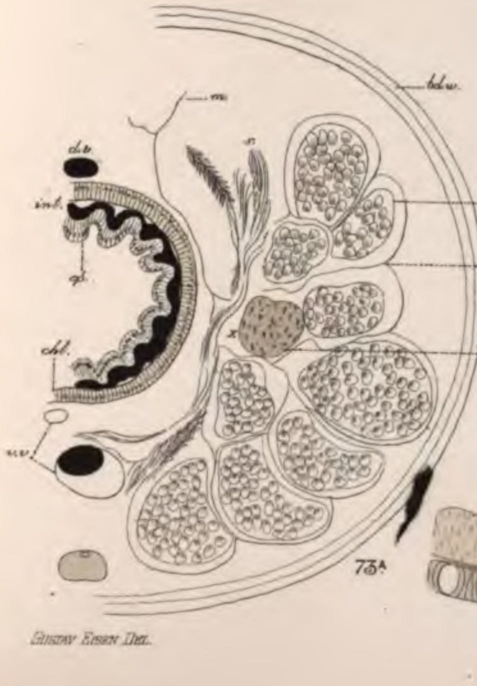
74.



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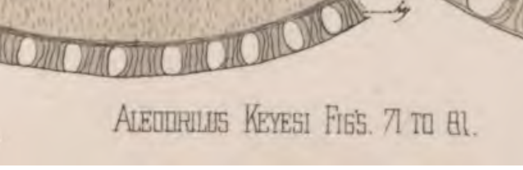

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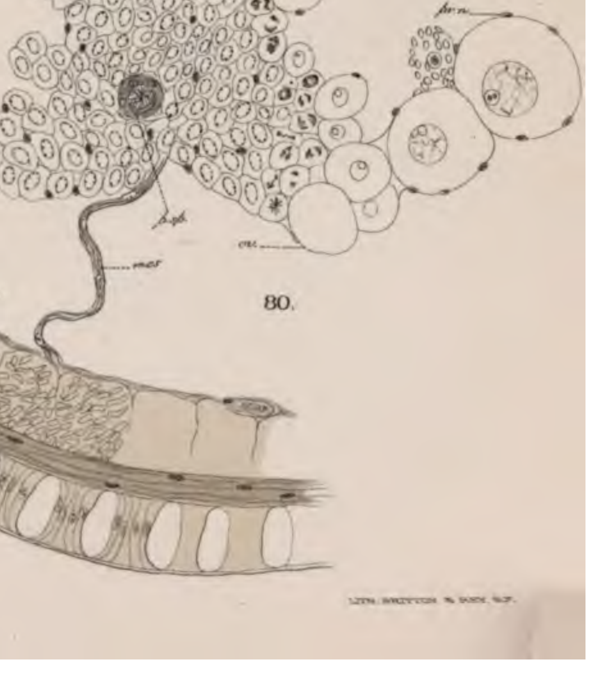

80.

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ALEODRILUS KEYESI FIG'S. 71 TO 81.

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ty. typhlosole.
u. c. unicellar glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE LII.

ALEODRILUS KEYESI.

82. Section through the epithelium of tubular intestine, showing a cluster of glands between the epithelial cells. *bl.* blood lacune.

83. Section through one of the valves of the heart. *l. c.* large cells at the base of the valves.

84. Some spermatogonia from the sperm-sacs in xii.

85. Cells from the central germinative and in the sperm-sac.

86. One of the nephridia with an anterior lateral vessel, connecting dorsally with a branch from the ventral vessel. *d. v.* diverticula of the lateral vessel. *lat. v.* lateral vessel.

ACANTHODRILUS TAMAJUSI.

87. The largest of my specimens, natural size. This specimen is strongly contracted, and was when alive considerably longer.

88. The anterior somites, ventral view.

89. The anterior somites, dorsal view.

90. The anterior somites, side view.

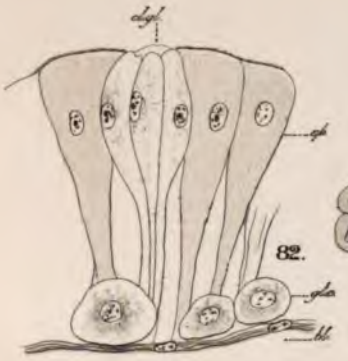
91. The ventral part of the genital region in the clitellum, showing genital papillæ, the three transverse genital ridges, penial setæ, common setæ, etc. The clitellum is not well developed, but in somite xx may be seen its posterior termination. The other one of my specimens, which possessed a more developed clitellum, had these papillæ less pronounced, though of the same form and arrangement.

92. Cross-section of the body-wall, showing the common setæ.

93. The free end of the penial seta.

94. The spermathecæ, dorsal view.

95. One of the spermathecæ dissected out.



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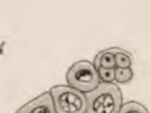

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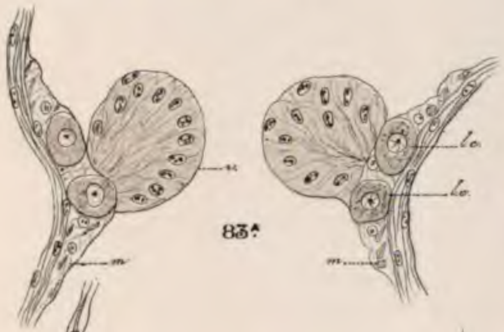

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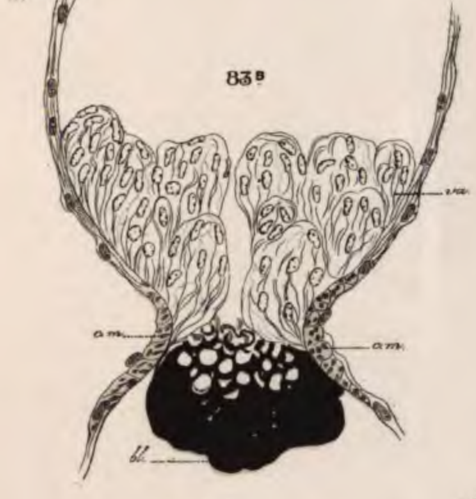

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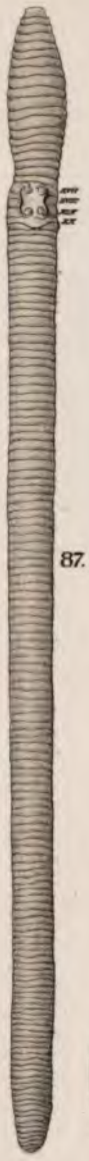

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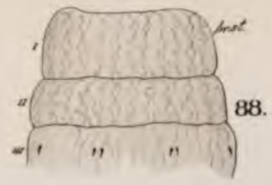

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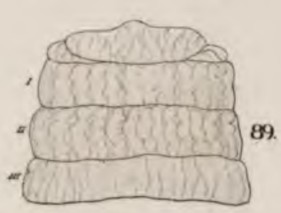

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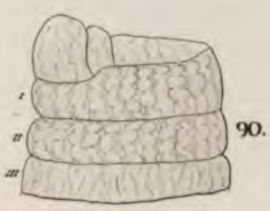

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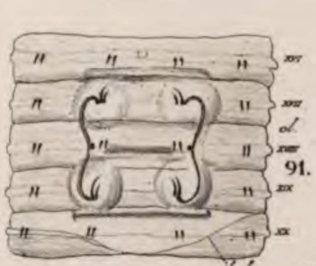

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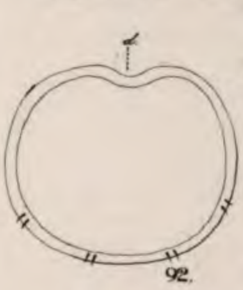

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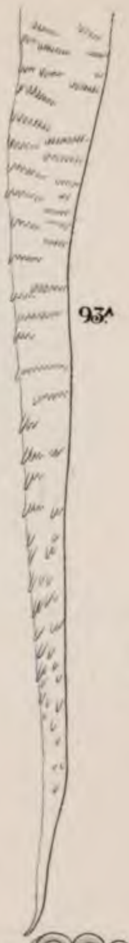

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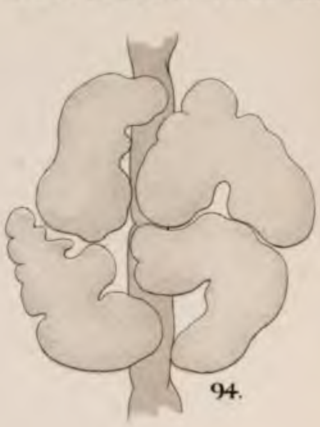

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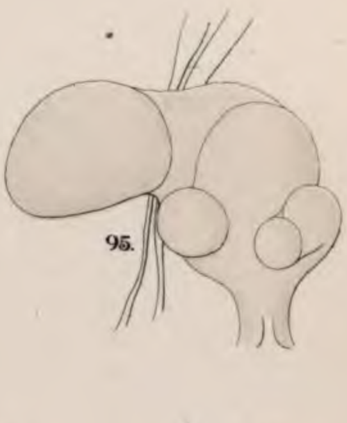

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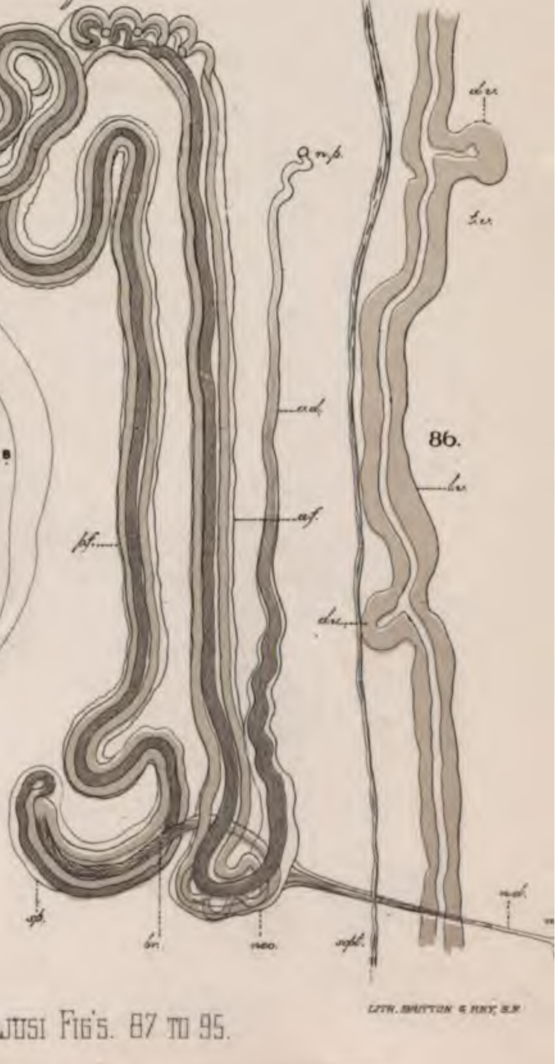

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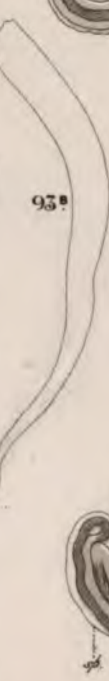
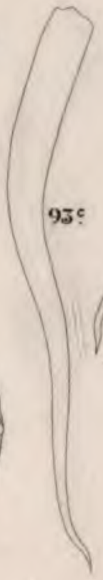
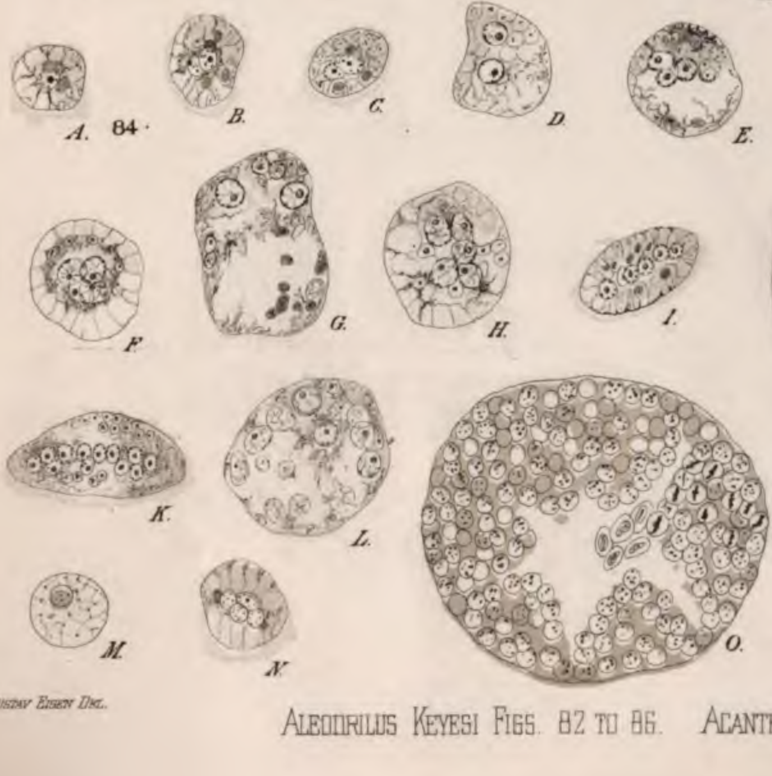


93B



93C



84.

GUSTAV EISEN DEL.

ALEODRILUS KEYESI FIGS. 82 TO 86. ACANTHODRILUS TAMAJUSI FIG'S. 87 TO 95.

LITH. BRITTON & REY, S.F.

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
n. nephridia.
n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. org. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE LIII.

ACANTHODRILUS TAMAJUSI.

96. A somewhat diagrammatic view composed from several longitudinal sections of the body. *r. m.* retractor muscles of gizzard. *c. c.* masses of free cœlomic cells.

SPARGANOPHILUS BENHAMI.

97. Adult specimen, natural size.

98. The anterior somites, ventral view, including clitellum, tubercula pubertatis, etc., magnified four times.

99. Longitudinal section of the anterior somites passing through the spermathecal and prostate pores, composed from several sections. Somites xix–xxii are not figured. *sep. gl.* septal glands which open in the dorsal part of the pharynx. *l. sep. gl.* lower septal glands which open in the ventral part of the pharynx. The spermathecæ have been cut through diagonally and the figure does not give any idea of their real shape.

101. Section of the body-wall in ventral part of somite xii. *p.* peritoneum. *n. ep.* nuclei of supporting cells.

102. Longitudinal section of the clitellum. *1.* Supporting cells. *2.* Unicellular glands. *3.* Short clitellar cells, staining deeply, and furnished with perfect nuclei. *4.* Largest clitellar cells, staining less deeply and with imperfect nuclei. Zeiss D.

103. A part of the same section, more magnified. Iron, hæmatoxylin, Haidenhein, Ehrlich 3 acid. Numerals indicate the same as in fig. 102. *d. n.* degenerate nuclei of the 4 cells. *n. sec.* cell plasma around the nuclei pushed far back in the apical part of the cell. *n. sh. c.* nuclei of the short clitellar cells surrounded by cell plasma and mucin. *c. t.* connective tissue. *bl. c.* blood capillaries which are very scarce in the clitellum of this species.

104. Section of the body wall in somite xiv.

105. Cross-section through clitellum and tubercula pubertatis. *1.* Supporting cells. *2.* Unicellular glands. *3.* Shorter clitellar cells staining darkly. *4.* The longer clitellar cells. *5. tpc.* tubercula pubertatis cells, largest kind. A few of these are seen to contain free but shrunken nuclei. *6. tpc.* tubercula pubertatis cells of the narrow kind, with cell plasma in the apical end, but also with shrunken nuclei. *t. p.* tubercula pubertatis groove. *n. f.* nerve fibers. *cl. c. 2.* large unicellular glands, a large form of the usual unicellular epidermal glands. Above these is seen a wide lumen, probably a blood vessel.

106. Longitudinal section of the body-wall, through spermatheca.

107. Longitudinal section of body-wall through prostate and pore in somite xxiv. *t. c.* tubular supporting cells. *g. c.* glandular cells confined to the zone around the intersegmental grooves.

108. The same as 107, more magnified.

109. The inner whorl of the ciliated rosette.

110. Section through the œsophagus. *i. c.* interstitial cells. *gl.* interstitial glands.

111. Section through intestine in somite xii. *fibr.* blood crystals and fibrine. *w. bl. w.* wall of blood sinus.

112. Section through upper pharyngeal wall, showing epithelial cells, and between them the discharge tubes of the glands. Zeiss 12, hom. im.

113. Section through the same part, showing a three-forked duct.

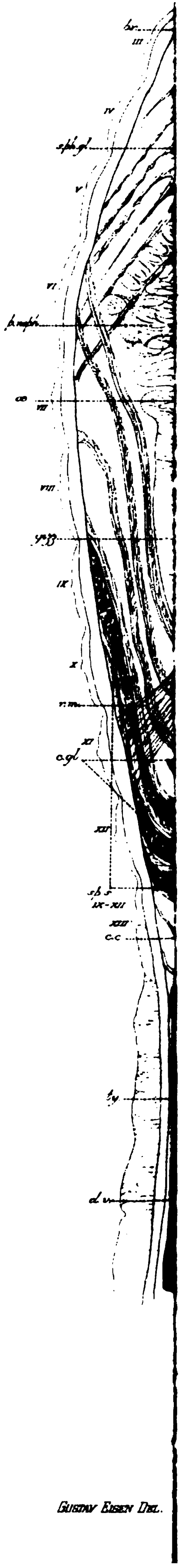
114. Section through the intestinal wall, next posterior to the real pharynx, showing larger discharge tubes and chambers.

115. Section through ventral wall of pharynx, with ducts and storage chambers of glands, and between them shorter epithelial cells. *m.* and *d.* muscles along which run the ducts. *n. d.* nuclei of ducts.

116. Surface view of one of the larger blood vessels.

117. Outline of one of the nephridia.

118. Outline of a spermatheca.



Gustav Eisen Del.

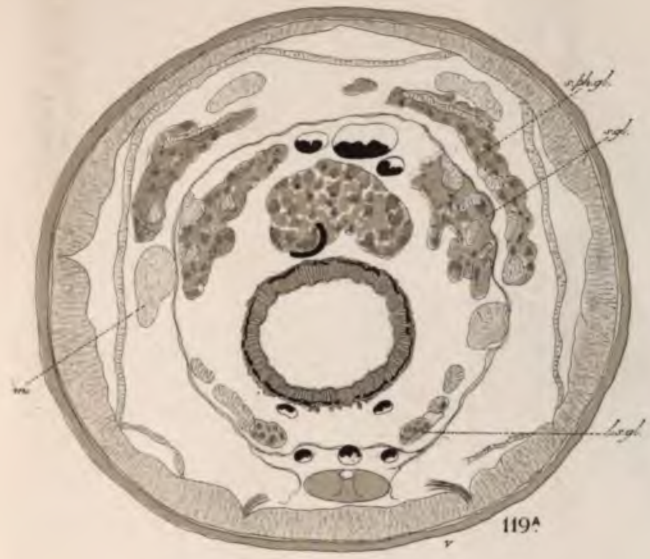
REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
n. nephridia.
n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. org. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

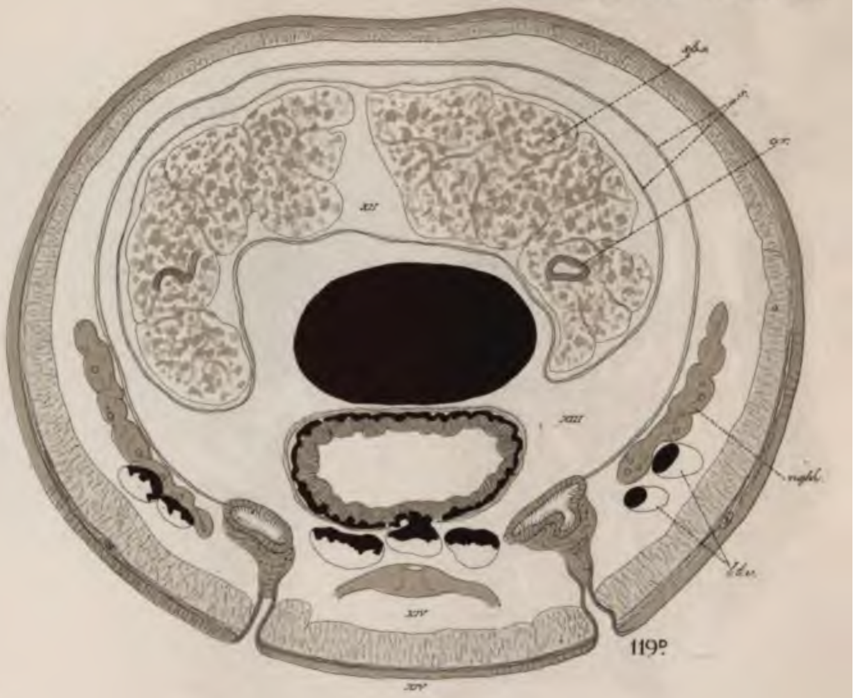
PLATE LIV.

SPARGANOPHILUS BENHAMI.

119. Five cross-sections through various parts of the body.
  - *a.* Through posterior part of pharynx in somite v. *s. gl.* dorsal septal glands. *l. s. gl.* lower septal glands.
  - *b.* Through spermathecæ and somites viii and ix.
  - *c.* Through somite x. *t. c. r.* tube of ciliated rosette.
  - *d.* Through oviduct, somite xiv with sperm-sacs.
  - *e.* Through clitellum in somite xix, showing tubercula pubertatis. *cl. c. 1* long clitellar cells. *cl. c. 2* short clitellar cells. *spd.* spermduct running below the muscular layers.



119A.



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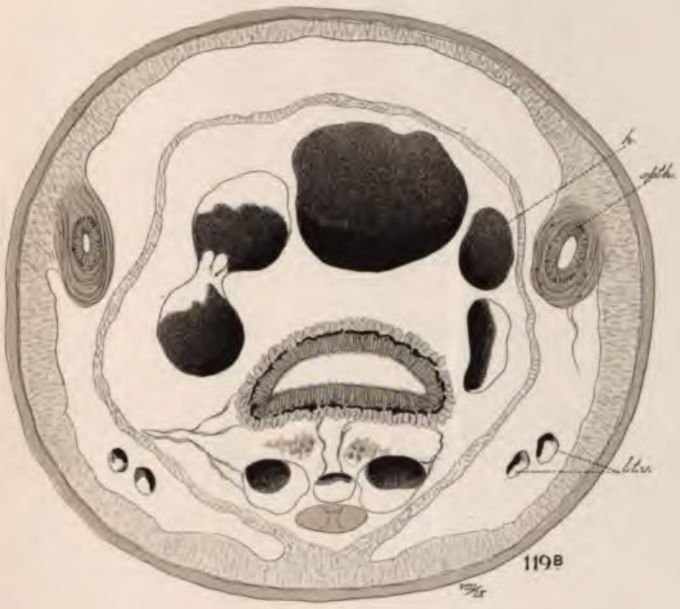
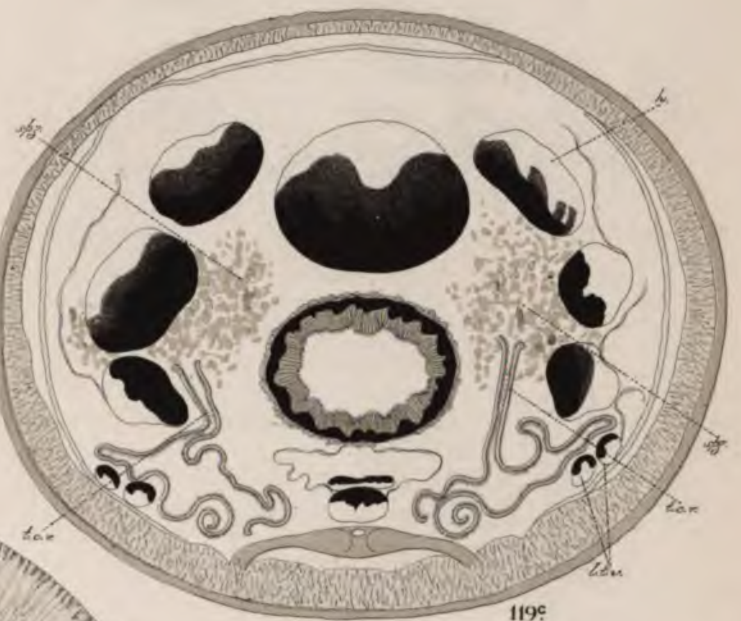
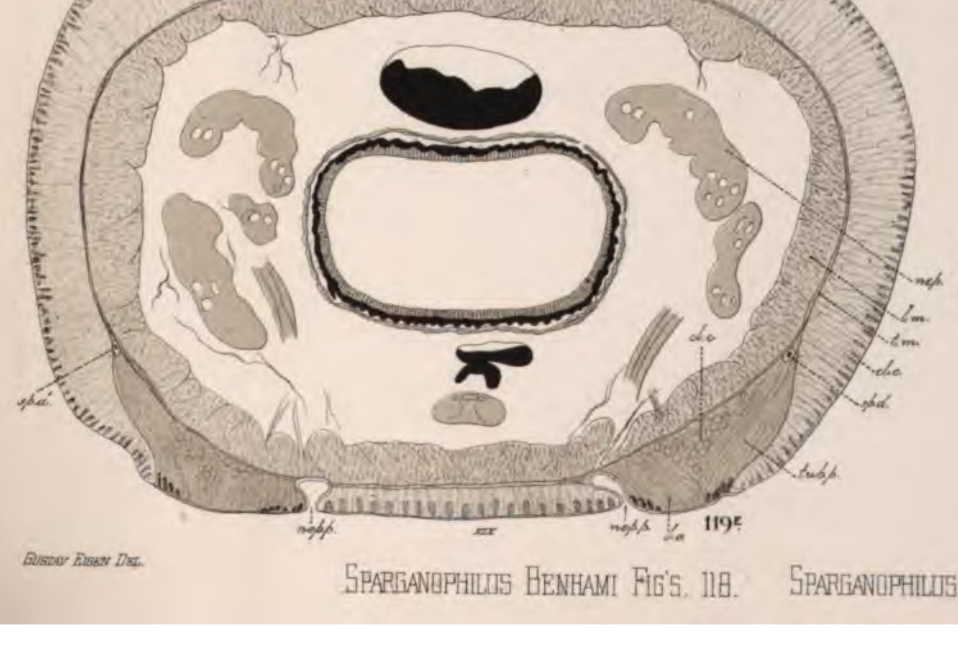


119B.



119C.



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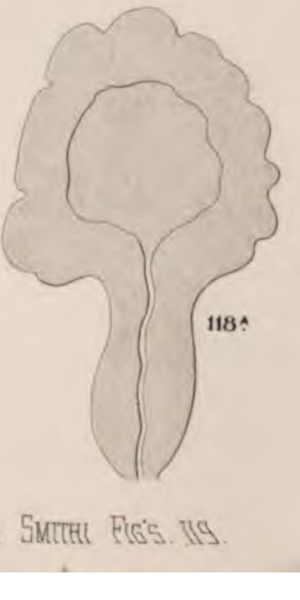
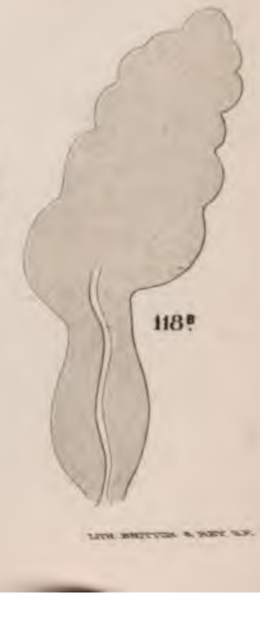


118A.



118B.

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SPARGANOPHILUS BENHAMI FIG'S. 118. SPARGANOPHILUS SMITHI FIG'S. 119.

Lith. Britton & Rey S.F.

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct.
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
c. ep. cœlomic epithelium.
c. gl. calciferous glands.
ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
c. m. circular muscles.
com. commissures.
c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
cu. cuticle.
d. gl. dark staining glands.
d. pr. dorsal pore.
d. v. dorsal vessel.
e. epithelial cells.
ept. epithelium.
gl. glands.
gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
h. heart.
hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
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n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. ory. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE LV.

SPARGANOPHILUS SMITHI.

120. A large specimen, natural size, ventral view.

121A. Anterior part of the body, side view, showing tubercula pubertatis ridges, and their anterior extension to the center of somite xi. The dorsal and ventral termini of clitellum marked by x.

121B. The anterior somites, ventral view. The spermiducal pore is seen about half way between setæ 1 and 2 and the tubercula pubertatis in xix/xi.

122. Two of the clitellar somites, side view, showing tubercula pubertatis ridge. *v.* ventral. *d.* dorsal side.

SPARGANOPHILUS SONOMÆ.

123. The same as 122, but from *Sparganophilus sonomæ*, showing the tubercula pubertatis ridge to consist of a succession of separate tubercles, two or three on every somite, with the groove very nearly in the center of each papilla.

SPARGANOPHILUS SMITHI.

124. Longitudinal section of the anterior somites, composed from several sections. *v. sgl.* ventral septal glands in v, vi, vii. *s. v.* spermtanks. *s. s.* sperm-sacs. *f.* four large folds of the dorsal vessel in somites xiv–xviii. *sp. gl.* prostates.

125. A series of outline drawings of spermathecæ from one specimen.

SPARGANOPHILUS SONOMÆ.

126. Outlines of spermathecæ from a single specimen.

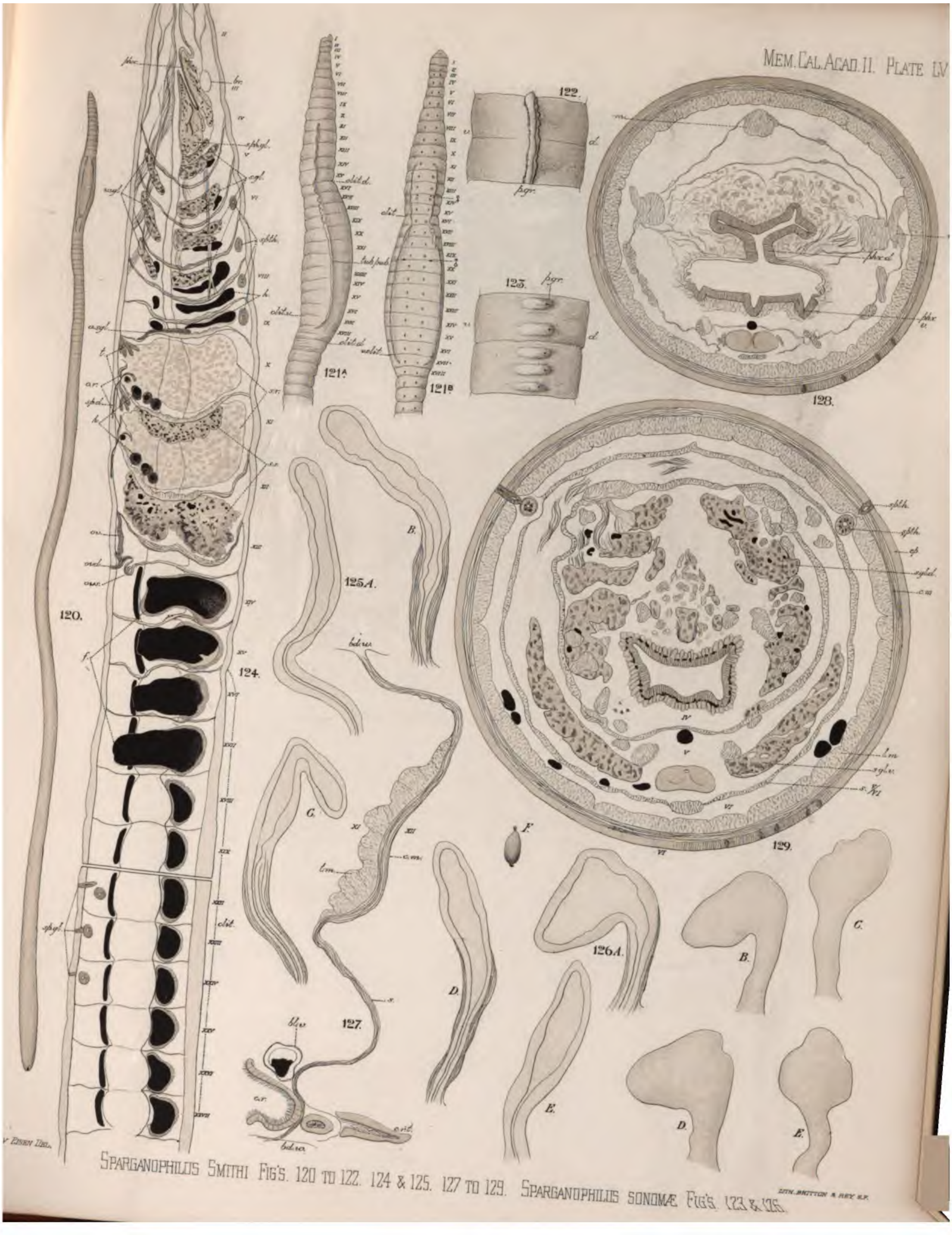
SPARGANOPHILUS SMITHI.

127. Cross-section of septum xi/xii.

128. Cross-section of the body; the Roman numeral indicates the somite.

129. Cross-section of the body; the Roman numerals indicate the somites.

MEM. CAL. ACAD. II. PLATE LV.



v Eisen Del.

SPARGANOPHILUS SMITHI FIG'S. 120 TO 122. 124 & 125. 127 TO 129. SPARGANOPHILUS SONOMÆ FIG'S. 123 & 126.

LITH. BRITTON & REY S.F.

REFERENCE TO LETTERS ON PLATES.

a. c. gl. anterior calcic gland.
a. f. anterior fold of nephridium.
a. nephr. anterior nephridia.
a. spd. anterior spermduct
atr. atrium.
bd. body-wall.
bl. blood vessel or capillaries.
bl. s. blood sinus.
br. bridge in nephridium.
buc. buccal cavity.
c. clusters of lunate cells.
c. c. columnar cells.
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cl. clitellum.
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c. r. ciliated rosettes or sperm-funnels.
c. t. connective tissue.
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u. c. unicellar glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE LVI.

SPARGANOPHILUS SMITHI.

130–136. Cross-sections through various somites. The details are indicated diagrammatically. The Roman numerals indicate the number of the somite or somites through which the section passes. *s. m.* septal muscles. *a. s. gl.* accessory septal gland of septum between somites ix and x. *spz. t.* spermatozoa in spermtanks. *spz. s.* spermatozoa and spermatogonia in sperm-sacs. *os.* ovisac. *a. m. t.* arciform muscles of tubercula pubertatis, connecting the opposite surfaces of the tubercula pubertatis. *a. m. c.* arciform muscles passing from opposite sides of clitellum through the cœlomic cavity.

137. Section through sacculated intestine. *bl. c.* blood capillary reticulum.

138. Tubercula pubertatis, Zeiss Hom. Im. $\frac{1}{12}$. *af. m.* arciform muscles passing through cœlom. *af. t.* arciform muscles confined to the epidermal cells of the tubercula.

139. Section through the body-wall through one of the prostates. *r. m.* retractor muscles passing to the cuticle and the outermost epidermal cells. *ct.* connective tissue.

SPARGANOPHILUS CARNEUS.

140. Two spermathecæ from the same specimens. The free or apical end is seen to be almost globular.

SPARGANOPHILUS GUATEMALENSIS.

141, a and b. Two spermathecæ. The apical end is flat and trawl-like, bearing a sac-like pouch which connects with the interior of the spermatheca, through a small slit.

DELTANIA TROYERI var. CRASSA.

142. A prostate gland with penial setæ.

143. A spermatheca.

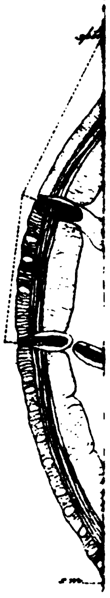
DELTANIA TROYERI var. LAGUNÆ.

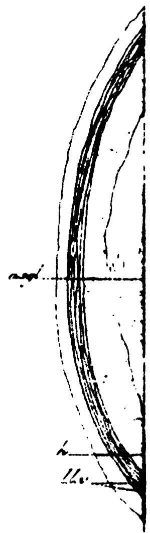
144. One of the penial setæ with the tip more highly magnified.

145. Two spermathecæ, both from the same specimen. *A* and *B* are seen from the broad side, *C* from the narrow side.

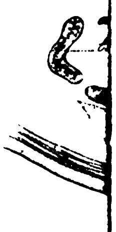
146. Two prostates with penial setæ. A is seen from the flat side, B is seen from the broad side.

147. Section of one of the ovisacs. Zeiss $\frac{1}{12}$, Hom. Im.





132.



Gustav Eisen Del.

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a. spd. anterior spermduct.
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ch. discharge chambers of glands.
chlo. chloragogen cells.
cil. ciliated epithelium.
cl. c. clitellar cells.
cl. clitellum.
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gl. c. unicellar glands.
gl. pr. glandular part of prostate.
gizz. gizzard.
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hy. hypodermis.
i. s. gr. intersegmental groove.
l. c. large cells.
l. m. longitudinal muscles.
m. muscles.
m. atr. muscular atrium.
mes. mesenteric tissue.
m. pr. muscular prostate.
n. nephridia.
n. c. nerve cells.
ne. nerve ganglion.
nec. neck of nephridium.
neph. nephridium.
neph. p. nephropore.
œs. œsophagus.
ov. ovary.
ovd. oviduct.
org. sense organ.
p. c. gl. posterior calciferous diverticulum.
p. f. posterior fold, nephridium.
phx. pharynx.
p. neph. posterior nephridia.
pr. prostate.
p. spd. posterior spermduct.
pr. sto. prostomium.
ps. penial setæ.
prt. peritoneum.
se. secreted matter.
s. int. sacculated intestine.
sep. gl. septal gland.
sep. septum.
s. gl. suprapharyngeal glands.
s. org. b. sense organ cells in equatoreal zone.
s. org. pr. sense organ cells in prostomium.
spc. sperm-cells.
spd. spermduct.
spgn. spermatogonia.
spr. spur of nephridium.
s. ps. sac with penial setæ.
sp. s. sperm-sacs.
s. ph. sgl. subpharyngeal glands.
spth. spermatheca.
spth. p. spermathecal pore.
t. testes.
t. m. transverse muscles.
trb. trabecula.
th. spd. thicker part of spermduct.
tu. tubular intestine.
tub. p. tubercula pubertatis.
ty. typhlosole.
u. c. unicellular glands.
v. g. ventral ganglion.
v. v. ventral vessel.
v. sgl. ventral gland.
w. "windings" of nephridial ducts.

PLATE LVII.

ACANTHODRILUS VASLITI.

148. The largest specimen, natural size, but not yet adult; the clitellum not developed.

149. Anterior part of a young specimen; clitellum not developed. The nephridia and some other detail not figured. *s. pl. sgl.* subpharyngeal salivary gland. *prc. ss.* peritoneal cells forming solid masses, probably surrounding rudimentary sperm-sacs. *prc.* large peritoneal cells lining the septa as well as the peritoneum. *a. p. pr.* anterior pair of prostates opening close together. *p. p. pr.* posterior pair of prostates.

150. Part of the ventral part of the body in somites xvii, xviii, xix laid open, showing prostates and thick septa with peritoneal cells. *m.* copulatory muscles. *a. pr.* anterior prostate. *p. pr.* posterior prostate both of the same pair.

151. Cross-section of the body-wall in somite xix, showing the prostate pore, and the two prostates opening close together.

152. Section through the same pore, three or four sections further back, showing the tubercula pubertatis, sense organ, etc. *deb.* debris. *sup. c.* supporting cells.

153. Part of a septum, showing the very large peritoneal cells, some of which are broader, others longer and narrower.

154. Cross-section of the two prostates. *p. pr.* posterior prostate pore. *a. pr.* anterior prostate pore. *prt.* peritoneal cells and connective tissue connecting the prostates with the body wall.

PHŒNICODRILUS TEPICENSIS.

155. Spermathecæ, side and front view of one and the same.

156. Cross-section of the body in somite xvii through the male pore, showing the copulatory region with muscular atrium and spermduct. The longitudinal muscular layer is greatly increased at the male pore. The muscular atrium is seen in cross-section, the cut passing through the whole length of that organ. This is also seen in figures 158, 159, the latter being taken from a section posterior to the former.

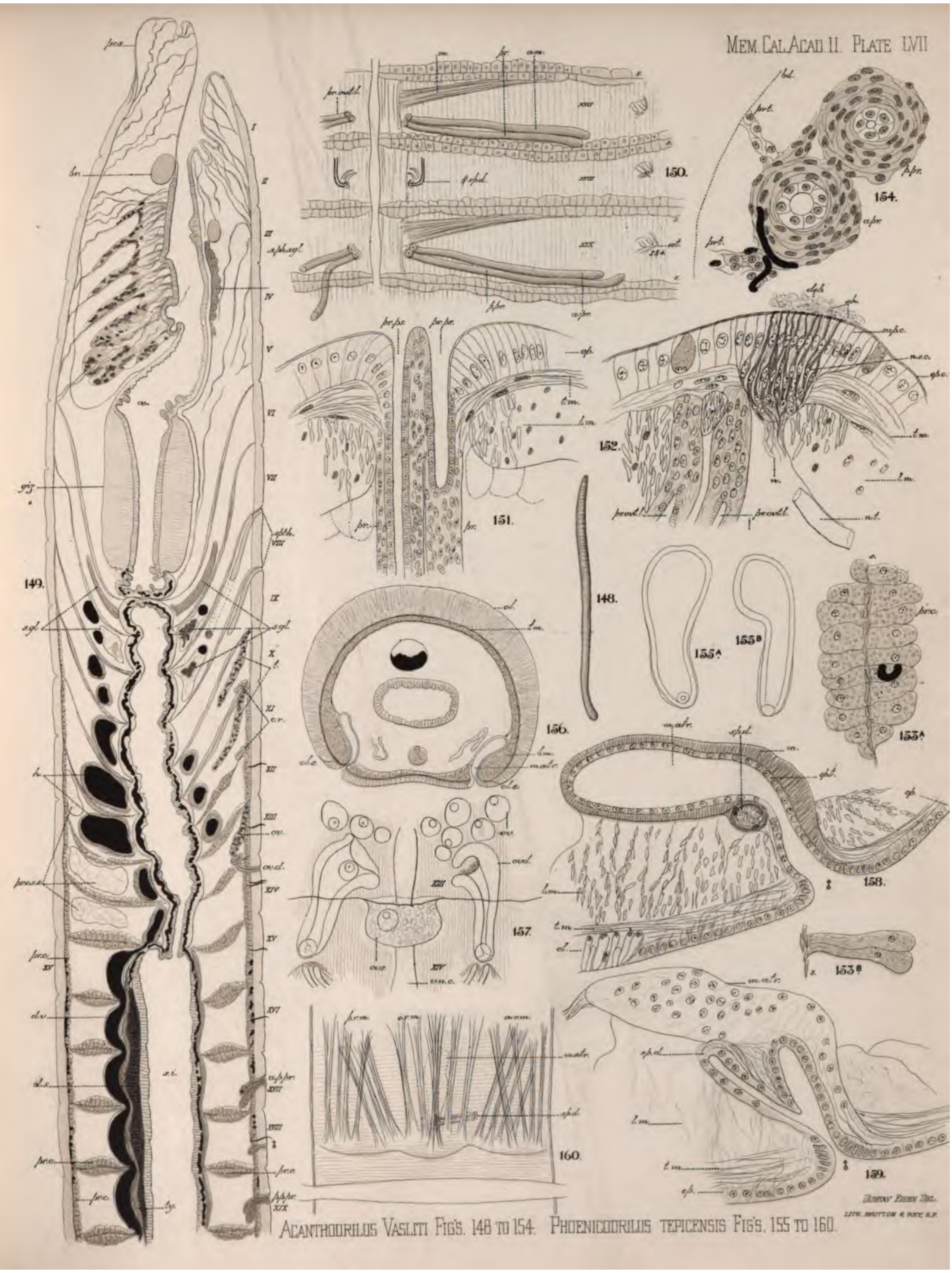
157. The oviduct, ovisac and part of the ovaries, interior view of the body.

158. Section through muscular atrium in cross-section of the body. The spermducts have not yet united, nor have they entered the atrium. The section passes through the whole length of the atrium. The arciform muscles must have been torn, as they did not show in the section.

159. The same parts as seen in fig. 158, but four sections further back, the section passes through the outer layers of the atrium. The two spermducts have united and are entering the atrium in line with the longitudinal muscular layer.

160. Arciform muscles around one of the male pores, viewed from the interior surface of the body. Only one side is shown.

MEM. CAL. ACAD. II. PLATE LVII



ACANTHODRILUS VASLITI FIG'S. 148 TO 154. PHOENICODRILUS TEPICENSIS FIG'S. 155 TO 160.

GUSTAV EISEN DEL.

LITH. BRITTON & REY, S.F.

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